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Expert Working Group on the Production of Panels from Agricultural Residues

Vienna, 14 - 18 December 1970

ANNOTATED BIBLIOGRAPHY ON THE UTILIZATION OF AGRICULTURAL RESIDUES AND NON-WOOD FIBROUS MATERIAL FOR THE PRODUCTION OF PANELS [1]

by

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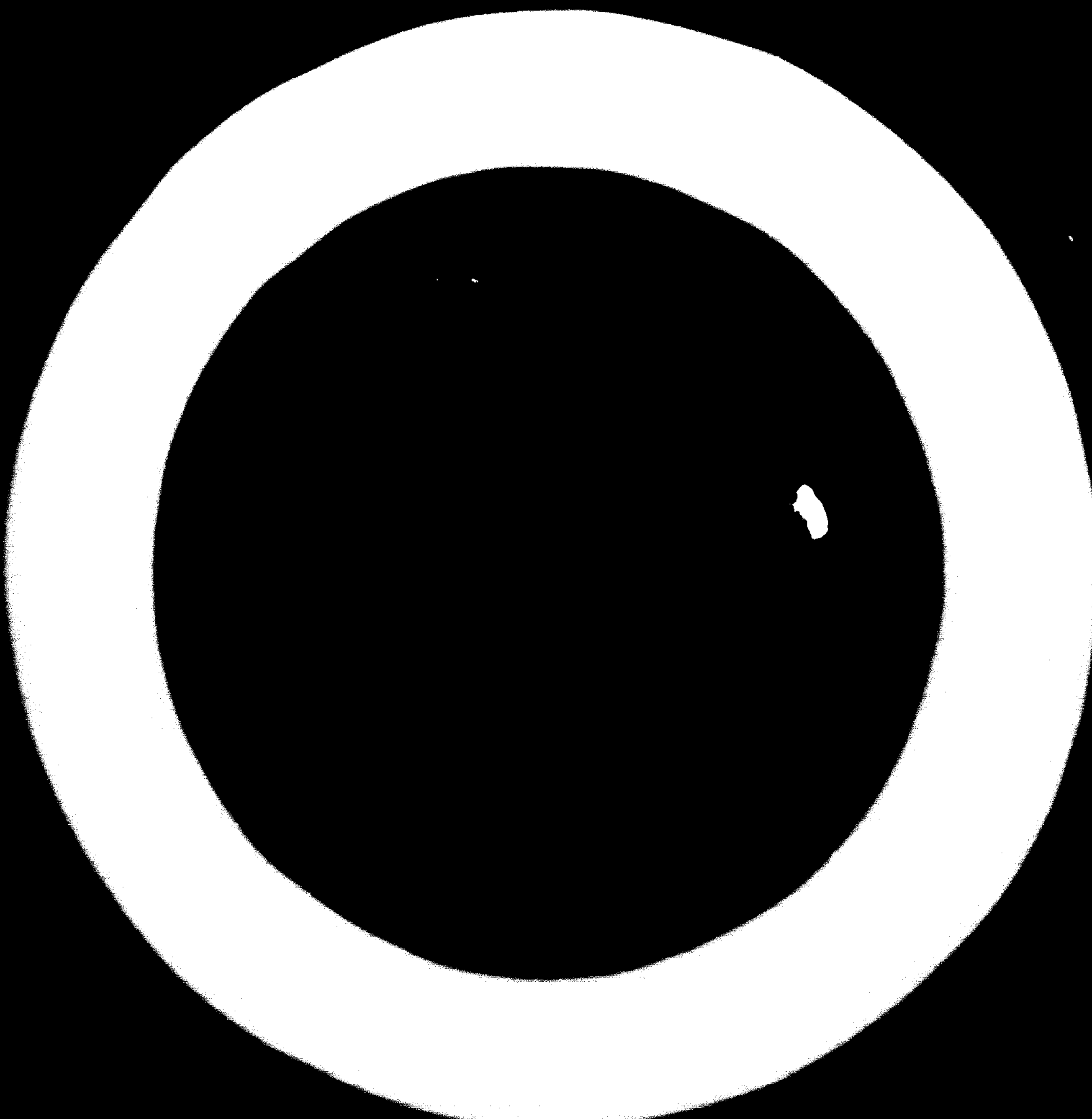

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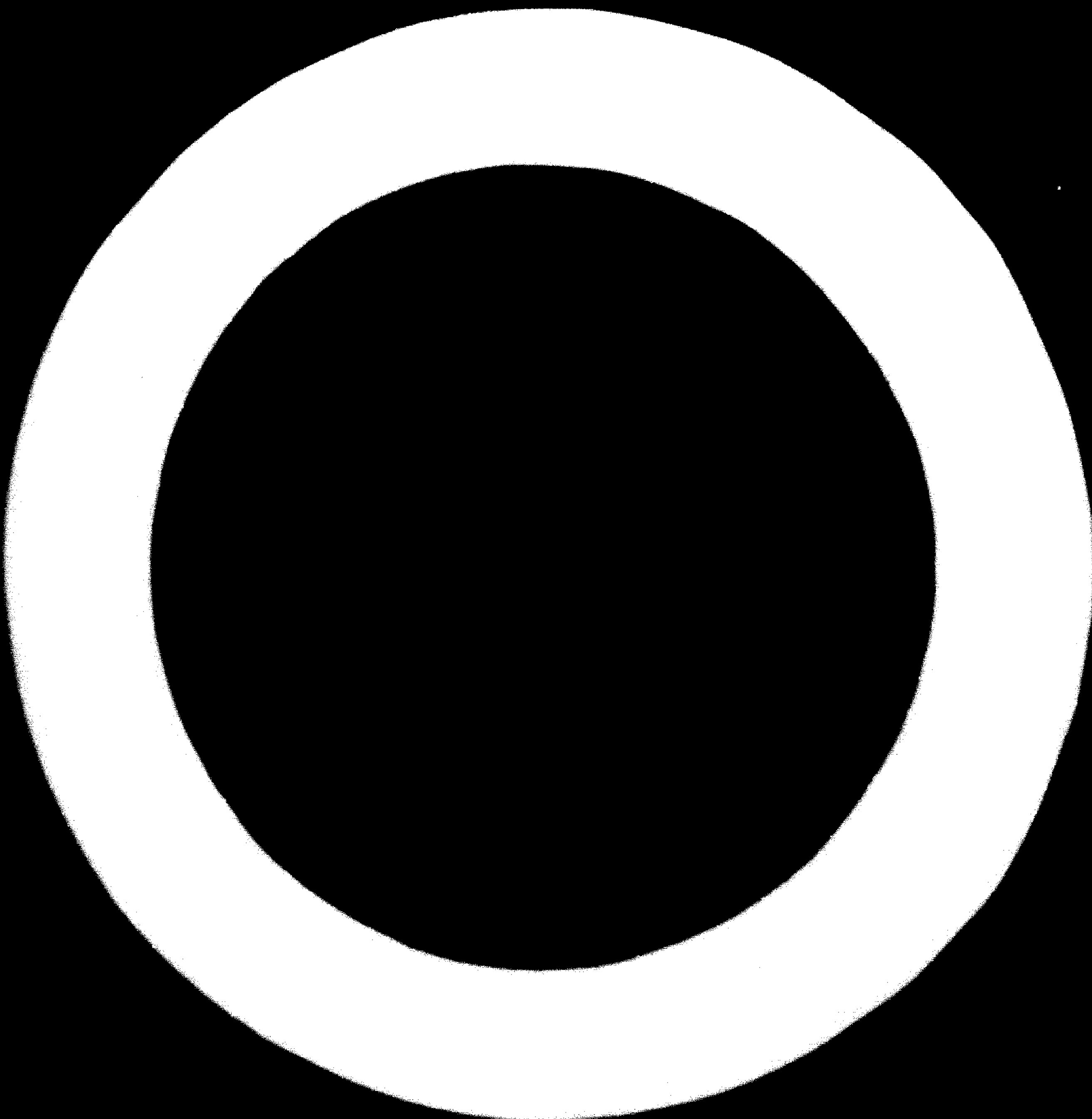

Preface

This bibliography on the utilization of agricultural residues for the production of panels was prepared in implementing a recommendation made by the Expert Working Group on the Production of Panels from Agricultural Residues, which UNIDO convened in Vienna from 14 to 18 December 1970.

Abstracts are arranged in five main subject categories (listed in the Table of Contents) each having sub-headings for the various fibrous raw materials, and a general section. When more than one category is discussed in the same abstract, the reference will generally appear in one category only. Within each category, however, cross-references are given for abstracts dealing with several raw materials.

In the preparation of this bibliography, the pertinent literature and the Abstract Bulletin of The Institute of Paper Chemistry was searched, the latter from the May, 1960 issue through the July, 1972 issue. Every effort was made to abstract the original paper. There were, however, cases in which the original article was not available, and the abstract had to be adapted from a secondary source.

ABBREVIATIONS USED IN THE BIBLIOGRAPHY

acad.	academic, academy
agr.	agricultural
Am.	American
assoc.	association
atm.	atmosphere(s)
biol.	biological, biology
bot.	botanical, botany
Brit.	British
Bull.	Bulletin
°C	degree(s) centigrade
ca.	circa: about
Can.	Canadian, Canada
chem.	chemical, chemistry
Chin.	Chinese
cm.	centimeter(s)
cu.m.	cubic meter
dept.	department
DIN	Deutsche Industrie Norm (German industrial standard)
div.	division
DP	degree(s) of polymerization
e.g.	for example
eng.	engineering
Engl.	English
etc.	et cetera
exptl.	experimental
°F	degree(s) Fahrenheit
Fr.	French
f.p.m.	foot per minute
ft.	foot, feet
g.	gram(s)
Ger.	German
govt.	government
ha	hectare (2.47 acres)
hr.	hour(s)
Hung.	Hungarian
i.e.	that is
incl.	including, inclusive
Inst.	Institute
intern.	international
ISO	International Standardization Organization
Ital.	Italian
J.	journal
Jap.	Japanese
kg.	kilogram(s)
km.	kilometer(s)
kw.	kilowatt(s)
lab.	laboratory
lb.	pound(s)
m.	meter(s)
mag.	magazine
min.	minute
ml.	milliliter(s)
mol.	molecular
natl.	national
no.	number
o.d.	ovendry
p.	page(s)
pat.	patent
PF	phenol-formaldehyde
pH	hydrogen-ion concentration
phys.	physical
Pol.	Polish
prod.	product
psi	pound(s) per square inch
Rep.	Republic
rept.	report
rev.	review
RH	relative humidity
Rom.	Romanian
Russ.	Russian
Scand.	Scandinavian
sci.	science, scientific
sec.	second(s)
sect.	section
ser.	series
Slovak.	Slovakian
soc.	society
sp.	species (singular)
spp.	species (plural)
sp.gr.	specific gravity
sq.cm.	square centimeter
°SR	degree(s) Schopper-Riegler (freeness)
std.	standard
suppl.	supplement
Tappi	Technical Association of the Pulp and Paper Industry
technol.	technological
UF	urea-formaldehyde
univ.	university
U.S.	United States

A. EARLY DEVELOPMENTS AND RESEARCH

General

1. Elmendorf, A.
   Cement-fiber board.
   U.S.pat. 2,332,703 ([illegible]).

The board consists of a skeletonlike porous slab formed of vegetable fibers coated with an inorganic cement.

2. Friedrich, K.
   The behavior of fiberboard toward wood-destroying fungi.
   Holz Roh-u.Werkstoff 4, no. 7:241-8 (July, 1941). (Ger.)

The attack of some wood-destroying fungi on fiberboard (insulating board, medium-density board, and hardboard) prepared from coniferous wood, straw, or bagasse was studied. Samples both untreated and treated with fungicides (arsenic and barium compounds, chlorinated hydrocarbons, dinitrocresol), bitumen, and natural and synthetic resins were tested. Aside from the arsenic compounds, all agents were more or less ineffective. Compared with wood standards, the insulating boards were more readily destroyed, the medium-density boards at least to the same extent, and the hardboards generally less. The boards prepared from the annual plants (straw and bagasse) seem to be particularly sensitive to fungus attack.

3. Hammer, H.
   Experimental board manufacture with hitherto unevaluated fibrous substitutes.
   Wochbl. Papierfabr. 77, no. 6:168-9 (1949). (Ger.)

The author discusses the possibilities of utilizing potato, tomato, and beet tops, tobacco stalks, poppy and mustard straw as raw materials for the manufacture of paper board. Although most of these agricultural residues give boards with satisfactory properties, their utilisation is not very promising because of difficulties encountered in collection, transportation, and storage.

4. Hinde, J.J.
   Wall board.
   U.S. pat. 1,755,781 (April 22, 1930).

Layers of hard fibrous material of the external casing of pithy plants, such as cornstalks, are alternated with layers of the internal pithy structure of the plants.

5. Hirschfield, A.
   Composite sheets for wall and ceiling coverings, partitions and electric insulation.
   Brit.pat. 328,985 (Feb. 8, 1929).

Glue or other suitable adhesive is applied to a sheet of metal or of sound-absorbing material such as bagasse, banana fiber, reeds, esparto grass, wood shavings, straw pulp, cork or seaweeds, and the material is then united with one or more sheets of a material such as cement asbestos and the composite sheet is subjected to heat and pressure.

6. Lathrop, E.C., and [illegible]ger, T.R.
Evaluation of [illegible] agricultural residues for structural building board products. I. Methods and equipment.
Paper Trade J. [illegible], no. 27:[illegible] (Dec., 1948).

The equipment and methods used at the Northern Regional Research Lab. for evaluating fibers for structural board manufacture are described. With sufficient study it is possible to determine a factor between the strength values of experimental boards and boards made from the same pulps on a commercial board machine. Data are presented showing the relationship between the moisture content of the board entering the drier and its physical properties. The high impact strength of boards made from bagasse or wheat straw is attributed to the long tough fibres which may be produced from these residues.

7. Narayanamurti, D.
The influence of resin supply in the development of a particle board industry in under-developed countries.
Composite Wood 4, no. 5:79-88 (Sept., 1957).

The establishment of a wood-particle industry in India would be advantageous. Lignocellulose wastes are plentiful, e.g. wood waste, bagasse, jute sticks, and other agricultural residues. The common particle-board adhesives, which would have to be imported, could be substituted for indigenous adhesives prepared from cashew shell oil, or bark tannins. The properties of boards made from various types of all-indigenous materials are described. 33 references.

8. Niven, C.D.
On the thermal conductivity of various insulators at room temperature.
Can. J. Research 9, no. 2:146-52 (Aug., 1933).

Studies were made on the thermal conductivity of organic and inorganic materials used in the walls of houses, such as wood-fiber, bagasse, cork, flax waste, concrete, etc. The results obtained indicated that at higher density thermal conductivity increased with increase of density much more rapidly than it did at low density.

9. Saechtling, H.
New procedures for the manufacture of building boards from cheap wood waste.
Holzforschung 2, no. 1:21-4 (1948). (Ger.)

The main feature of the new process described by the author is the development of adhesive properties on beating or grinding of wood waste, thus eliminating the necessity of adding large amounts of binders. Other raw materials, such as rape straw, flax chaff, heather, etc., can also be used, provided that the procedure is adapted to the requirements of each special material. Data are given on the physical properties of the boards (trade name Tronal, Tronex, etc.).

10. Weber, C.G., and Weissberg, S.G.
Properties of some fiber building boards of current manufacture.
U.S. Natl.Bur. Standards, Report BMS 13, Feb. 23, 1939. 5 p.

Test data are given showing the properties of fiber building boards that are under study in connection with research on low-cost house construction. The test methods are described.

11. Williamson, R.V.
Method of making lignocellulose pressure molded articles.
U.S. pat. 2,645,587 (July 14, 1953).

Mixtures of comminuted materials, such as nutshells, straw, rice hulls, corncobs, peanut shells, bagasse, and flax shives, and a thermoplastic binder (Vinsol, rosin, etc.) are heated in the absence of oxygen to 200-300°C. When incorporated in molding compositions for boards, slabs, tile, etc., this material exhibits an unusual degree of dimensional stability to water.

12. Williamson, R.V., and Lathrop, E.C.
Hardboard from agricultural residues.
Mod. Plas. 28, no. 8:126,128,130,187 (April, 1951).

The possibility of utilizing rice hulls, peanut shells, and flax shives for producing hardboard was investigated. Mixtures of the ground residues and (1) Vinsol (a commercial resin obtained as a by-product in the manufacture of rosin), or (2) PF resin and pine gum were pressed at high temperatures giving boards of good strength and water resistance. Because of their superior physical properties, most of the study was devoted to boards made from peanut shells.

13. World's Paper Trade Review.
Raw materials for wallboard; experiments with agricultural and wood working residues.
World's Paper Trade Rev. 141, no. 8:587-8, 590 (Feb., 1954).

In answer to an inquiry by an Italian firm on processes for making framings for dwellings from agricultural and woodworking residues, the Mutual Security Agency described briefly the use of these materials, including straw, bagasse, rice hulls, peanut hulls, wood waste, etc.

<u>Areca-nut husk</u>

14. Narayanamurti, D., Ranganathan, V., and George, J.
Studies on building boards. I. Utilisation of areca nut husk.
Forest Res.Inst., Dehra Dun, Indian Forest Leaflet no. 112, 1948. 9 p.

Laboratory experiments for preparing building boards from areca-nut husk waste are described.

<u>Bagasse</u>

15. Becker, G.
Board making in the Bushveld.
Paper-Maker 113, no. 2:84, 87 (Febr., 1947).

Description of the building board plant at Messina, northern Transvaal. Bagasse is used as a raw material. Although the equipment is assembled from parts which happened to be available, the properties of the boards are comparable to those produced with conventional equipment.

16. Bhargava, M.P., and Nayer, A.N.
Manufacture of insulation and pressed board, etc., from bagasse.
Int. Sugar J. 45:95-7 (1943).

The processing of bagasse into boards using the Asplund Defibrator for preparation of the stock is described in detail. The methods of moisture- and fireproofing and preservation of boards are reviewed. Finally, estimates of the production cost and profits are presented.

17. Börger, H.E.A.
Paper and board from bagasse.
Wochbl. Papierfabrik. 81, no. 13:476, 478, 480 (July, 1953). (Ger.)

The various attempts for making paper and board from bagasse, with particular reference to the Celotex and Vazcane processes, are reviewed. Data of the chemical composition of bagasse and the length of its fibers, which varies with the species, are presented.

18. Cunningham, W.A.
Strong plaster for paperless wallboard.
Rock Products 45, no. 4:50-3 (1942).

The manufacture of a bagasse fiber board having a tensile strength of 340 and a compressive strength of 1000 lb./sq.in. is described in detail.

19. Dahlberg, C.F.
Plaster board.
U.S. pat. 1,503,783 (Aug., 1924).

A heat-insulating plasterboard is claimed consisting of a body portion and a supporting base of compressible fibrous bagasse. Both portions are coated with pitch, asphalt, or other waterproofing material.

20. Friedrich, K.
The behavior of fiberboard toward wood-destroying fungi.
Holz Roh- u.Werkstoff 4, no. 7:241-8 (July, 1941). (Ger.)

(see abstract no. 2).

21. Goldsmith, W.F.
Hawaii's new insulation board plant possesses many advantages.
Paper Trade J. 95, no. 17:19-21 (Oct., 1932).

Description of the Hilo, Hawaii, mill which was erected for converting bagasse into structural insulation board.

22. Kato, H.
Utilization of bagasse. II. Drying of bagasse board.
Cellulose Ind., Tokyo 10, no. 10:289-93 (1934).

Equations for adiabatic parallel flow and isothermic counter-flow are deduced.

23. Kato, H.
Utilization of bagasse. III. The physical properties of Celotex.
Cellulose Ind., Tokyo 10, no. 12:312-15 (Dec., 1934).

The thermal conductivity of fiberboard made from bagasse (Celotex) shows it to be suitable for use in buildings as a heat-insulating medium.

24. Kato, H.
Studies on utilization of bagasse. IV. Physical properties of Celotex (Part 2). Tensile strength, bending strength and hardness.
Cellulose Ind., Tokyo 11, no. 3:10 (March, 1935).

Several physical properties of fiberboards made from bagasse (Celotex) were tested.

25. Kato, H.
Studies on utilization of bagasse. V. Physical properties of Celotex (Part 3). Surface color and its change.
Cellulose Ind., Tokyo 11, no. 6:19 (June, 1935).

Since exposure to outside atmospheric influences changes the color of Celotex, it should be protected by painting; indoors it will keep in its original condition for a long period.

26. Kato, H.
Studies on utilization of bagasse. VI. Physical properties of Celotex (Part 4). Ignition point.
Cellulose Ind., Tokyo 12, no 3:20 (March, 1936).

The ignition points of four different samples of Celotex were found to lie between 203-222°C.

27. Kato, H.
Studies on utilization of bagasse. VII. Some measurements of thermal influences in a Celotex-room.
Cellulose Ind., Tokyo 12, no. 4:23 (April, 1936).

Variations of temperature, humidity, and vapor pressure inside a house built with Celotex walls were found to be much smaller inside than outside.

28. Lathrop, E.C.
The Celotex and cane sugar industries. Bagasse or sugar a by-product?
Ind. Eng. Chem. 22, no. 5:449-60 (May, 1930); Wochbl. Papierfabr. 61, no. 39:1252-7 (Sept., 1930); Zellstoff u. Papier 11, no. 1:28-9 (Jan., 1931).

Celotex is an artificial building board made from bagasse. The bagasse from the cane mills is compressed into 250-lb bales which are stored in covered piles. During storage the residual sugar in the bagasse rapidly undergoes fermentation, and the fibers become softened and retted. After cooking under pressure the material is shredded, sized, etc., and eventually pressed and dried.

29. Lathrop, E.C.
Celotex, its manufacture and uses.
Trans.Am.Inst. Chem.Eng. 25:143-55 (1931).

The present methods of manufacture of Celotex fiber board, the main properties of the products, and their more interesting uses are described. Bagasse is used as a raw material.

30. Lathrop, E.C.
Economic factors to be considered in the use of sugarcane bagasse as a raw material for paper and board manufacture.
U.S. Department of Agriculture, Bull. ARS-71-2 (Nov., 1954).

The economics of paper and board manufacture from sugarcane bagasse are discussed.

31. Lathrop, E.C., and Irvine, F.A.
Process of making panel board.
U.S.pat. 1,881,418 (Oct.4, 1932).

A process is claimed for manufacturing a panel board from bagasse.

32. Lathrop, E.C., and Naffziger, T.R.
Evaluation of fibrous agricultural residues for structural building board products. I. Methods and equipment.
Paper Trade J. 127, no. 27:53-60 (Dec., 1948).

(see abstract no. 6).

33. Munroe, T.B.
Heat-insulating plaster-board.
U.S. pat. 1,486,535 (March 11, 1924).

The board consists of a heat insulating bagasse material which has been covered on each side with a layer of asphalt in which is embedded finely divided rock material.

34. Pacific Pulp Paper Industry.
A new $ 2,500,000 mill in Hawaii.
Pac. Pulp Paper Ind. 6, no. 4:22-3 (April, 1932).

Description of a new insulating board mill at Hilo, which converts bagasse after a special process into "Canec" structural insulation.

35. Pulp Paper Industry.
Celotex Corporation expands in United States and Britain.
Pulp Paper Ind. 20, no. 9:26 (Aug., 1946).

The operations of the Celotex Corp. in its various plants, all utilizing bagasse as a raw material for structural and insulating board, are briefly described.

36. Shaw, J.K.
Plaster board.
U.S. pat. 1,503,211 (July 29, 1924).

A heat-insulating plasterboard is formed with a relatively unyielding hard and strong layer of bagasse fibers interlaced with a relatively soft and yielding layer of bagasse fibers, all the bagasse fibers used being associated with their natural pith, and with an attached layer of plaster.

37. Singh, S.C.
Manufacture of boards and paper from bagasse.
J.Sci. Ind. Research (India) 3:399-404 (1945); Tech. Bull., Paper Makers' Assoc. Gt.Brit. Ireland 22, no. 4-6 (April-June, 1945).

Studies carried out at Dehra Dun indicated that the Asplund process would be the most suitable for making insulating and pressed board from bagasse. Methods and agents are described which were found to give the necessary proofness against moisture, termites, and molds, and render the boards reasonably fire-retardant.

38. Southern Pulp Paper Journal.
The rise of Celotex.
Southern Pulp Paper J. 2, no. 3:6-11 (Aug., 1939).

The Celotex process of manufacturing fiberboards from bagasse is described. The chief application of the board is for construction and insulation.

39. Temple, G.
Utilizing waste.
Science Progr. 22:475-80 (1928).

A description of the manufacture of Celotex insulating board using bagasse as a raw material, and its properties is given.

40. Vasquez, E.A.
Comparative examination of some insulating boards.
Mem.asoc.tecnicos azucar. Cuba 20:441-7 (1945).

Description of the processes for making board from old and fermented bagasse, and from fresh bagasse directly after crushing.

41. Whittemore, H.L., and Stang, A.H.
Structural properties of wood-frame wall and partition constructions with Celotex insulating boards.
U.S. Natl. Bur. Standards, Building Materials and Structures, Report BMS 42, March 2, 1940. 25 p.

In connection with the program on low-cost house construction, the properties of two wall and two partition constructions submitted by the Celotex Corp. were tested. The results are presented in graphs and tables.

42. Williams, W.L.S.
Wallboard material from bagasse.
U.S. pat. 1,847,050 (Febr. 23, 1932).

Pith is removed from shredded fibers by screening, by cooking the material under pressure with 4-6% of calcium oxide (on the weight of the fiber) and simultaneously submitting the fibers to mechanical abrasion, and finally by passing it through the pulper.

Bamboo

43. Datta, K.
Investigations on the use of bamboo as reinforcement in concrete structures.
Bauing. 17, no. 3/4:17-27 (1936). (Ger.)

The design and properties of bamboo-reinforced concrete structures are described. Provided the reinforcement is mounted in a proper way, some increase in strength will result.

44. Narayanamurti, D., and Bist, B.S.
Building Boards. II. Boards from bamboos.
Forest Res.Inst., Dehra Dun, Indian Forest Leaflet no. 103, 1948. 12 p.

Preliminary experiments on the production of building boards from bamboo are described. The possibility of commercial production of such materials from mats woven from bamboo sticks and bonded by a small percentage of synthetic resins and fillers is discussed.

Coconut husks and coir

45. Journal of Scientific and Industrial Research.
Industrial utilisation of coir.
J. Sci. Ind. Res., India 2:174 (1944).

Fiberboards were made by treating disintegrated beaten coir with shellac followed by boiled linseed oil. After the mixture had been exposed to the sun for four hr. to promote oxidation, it was pressed for 30 min. at 130°. The resulting boards were hard, did not warp, and showed a high chemical resistance to water, cold 10% sodium carbonate, and dilute nitric acid.

46. Menon, S.R.K.
Coconite (fiber board from immature coconuts).
J. Sci. Ind. Res., India 2:172-4 (1944).

Fiberboards were made from windfall immature coconuts which were shredded and boiled with water. The product was pulped and mixed with waste paper, rosin, and alum. For preparing the sheets, the common fiberboard technique was used, the pressing conditions being 20 min. at 160°C and 560 lb./sq.in. The boards are strong and tough and have good heat- and sound-insulating properties.

47. Schueler, G.B.E.
Uses of coconut products.
Modern Plastics 23, no. 10:118-9 (June, 1946).

This article mainly deals with the use of coconut shell flour as a filler for plastics. Tabulated data of the physical properties of the molded products are given. Applications with coconut shell fibers have been few, but in India they have been used with shellac as a binder for making hard fiberboards.

Cornstalks and corncobs

48. Arnold, L.K.
Making insulation board from cornstalks.
Cellulose 1:272-5 (1930).

A process for the manufacture of insulation board from cornstalks is described. The stalks are digested for 2 hr. at a pressure of 100 lb./sq.in., after having been broken up with a cutter and a swing hammermill. Rosin size is added to the washed stock before refining. The board is formed on a special machine. The stalks can also be disintegrated, without previous cooking, in a Bauer refiner.

49. Arnold, L.K.
Acoustical board from cornstalk pulp.
Paper Ind. 20, no. 5:547-50 (Aug., 1938).

Studies are described which indicate that it is possible to make excellent acoustical boards from cornstalks. The absorption coefficient may be varied over a wide range, and depends on pulp composition, number of grooves, and number of holes. The results are tabulated.

50. Arnold, L.K.
Low-temperature drying of cornstalk insulating board.
Paper Ind. 20:48-51 (1938).

At ordinary room temperature and low humidity, drying of insulating board made from cornstalks requires about four days whereas about two weeks are necessary at summer temperatures and humidities. Practically no drying occurs below freezing.

51. Arnold, L.K., and Gleaves, D.L.
The adsorption of zinc chloride by cornstalk insulating board pulp.
Paper Trade J. 98, no. 24:31-3 (June, 1934).

The decay of cornstalk insulating board can be retarded by the admixture of zinc chloride to the refined pulp before forming into the wet mat. Some part of the preservative is firmly adsorbed by the pulp. Since no data on this subject were available, a study of the adsorption of zinc chloride by board pulp was made and a suitable analytical method developed for this purpose.

52. Arnold, L.K., Plagge, H.F., and Anderson, D.E.
Cornstalk acoustical board.
Iowa Eng. Expt. Sta., Bull. 137, 1937. 47 p.

The sound-absorption properties of various acoustical boards made from cornstalks and the effect of pulp composition and surface treatment were studied. The results showed the suitability of cornstalks as a raw material for acoustical boards.

53. Emley, W.E.
Insulating board from cornstalks.
Paper Trade J. 88, no. 25:61-2 (1929).

A brief outline is given of the semicommercial experimental work carried out by the Bureau of Standards, in co-operation with Iowa State College, from 1927 to 1929.

54. Hartford, C.E.
Making boards from cornstalks at Dubuque.
Paper Trade J. 91, no. 18:80-2 (Nov., 1930).

The manufacturing process used at the Dubuque mill for converting cornstalks into insulating board is described. The shredded stalks are cooked under pressure for 2 hr., yielding a pulp which is sized, formed into a mat, pressed, and dried.

55. Hartford, C.E.
The production of insulating board from cornstalks.
Ind. Eng. Chem. 22, no. 12:1280-4 (Dec., 1930).

A detailed description of the manufacture of "Maizewood" insulating board from cornstalks and the properties of the products are given. A considerable bibliography of various proposed processes for the utilization of corn waste is included.

56. Kirkpatrick, S.D.
Cornstalks as chemical raw materials.
Chem. Met. Eng. 35:401-3 (1928).

Experiments on production of wallboard and pulp from cornstalks are briefly described.

57. Lathrop, E.C.
Industrial utilization of corn crop residues.
Chemurgic Digest 7, no. 6:20-6 (June, 1948).

The author discusses the availability and utilization of corn residues. Satisfactory insulating boards have been made commercially from cornstalks, but because of high collection costs, the manufacture has been abandoned. The successful use of cornstalks for papermaking also depends, in large part, on their economical collection. The leaves should be left on the farm since they are of little value in papermaking.

58. Naffsiger, T.R.
I. Some factors affecting the production of insulation board.
II. The development of the commercial production of refrigeration board and pressboard.
Iowa State Coll. J. Sci. 9, no. 1:183-5 (Oct., 1934).

The properties of a number of commercial boards were tested, and experiments were made with different fireproofing, moldproofing, and sizing agents. A good grade of refrigeration board was obtained from the pith of cornstalks, better than from the whole stalk.

59. Northern Regional Research Laboratory.
Industrial uses of corncobs.
Chemurgic Digest 2, no. 7:49, 52-3 (April, 1943).

The different possibilities of utilising corncobs industrially are reviewed.

60. Plagge, H.J., Arnold, L.K., and Whittemore, E.R.
The surface treatment of acoustic tile.
Paper Trade J. 96, no. 6:27-9 (Feb., 1933).

The effect of several types and degrees of surface treatment on the sound-absorption coefficient of cornstalk fiberboard was studied. It was found that acoustic tile has a specific absorption coefficient characteristic of the fiber mass. It can be designed by a proper balance of bevel, number, width, and depth of grooves to have any specific absorption coefficient over a wide range.

61. Porter, R.W.
Modernization at Maizewood's insulating board mill.
Paper Ind. 32, no. 3:270-4 (June, 1950).

Maizewood's board mill at Dubuque, Iowa, making insulating board from cornstalks since 1929, has been modernized. It is now in the position to utilize practically any type of fibrous material, including straw, flax shives, hemp, wood, and waste paper. The processes and equipment employed are briefly described.

62. Sweeney, O.R.
Production of synthetic lumber from cornstalks.
U.S. pat. 1,803,737 (May 5, 1931).

Unshredded cornstalks are cooked under pressure of 30 psi in water of pH 7 for 3 hr., allowed to remain in the water for a further 4-24 hr., macerated in a rod mill to produce fibers several inches in length, and washed on a sieve. The pulp is then formed into boards by pressure in the usual way.

63. Sweeney, O.R., and Arnold, L.K.
Studies on the manufacture of insulating board.
Iowa Eng. Expt. Sta., Bull. 136, 1937. 75 p.

Light-colored and strong insulating board was made from cornstalk pulp cooked in water at atmospheric pressure for 3 hr. The addition of repulped newsprint (up to about 20 %) improved the strength of the board. The optimal forming consistency and sizing conditions were determined. High-density boards were made by cold pressing followed by drying or by drying under pressure. Surface coatings were found to increase the strength and to reduce the air permeability of the board. Drying tests were conducted varying the temperature, humidity, pulp composition, and type of drying equipment.

64. Sweeney, O.R., and Arnold, L.K.
Moisture relations in the manufacture and use of cornstalk insulating board.
Iowa Eng. Expt. Sta., Bull. no. 163, Oct. 20, 1948. 35 p.

The moisture effects in drying and application of cornstalk and other insulating boards were studied. It was found that boards having a high initial moisture content absorbed less water upon immersion than dry boards, although the total final moisture content was greater in the former.

65. Sweeney, O.R., and Emley, W.E.
Manufacture of insulating board from cornstalks.
Bureau of Standards, Misc. Publ. no. 112, 1930. 27 p.

The shredded stalks, in some cases after digesting with water either with or without the addition of chemicals, were pulped by means of a Hollander beater, and a swing hammer mill or a rod mill. After refining and washing, the pulp was fed on to a modified Oliver filter and the mat pressed in three sets of heavy rolls. The resulting boards have properties similar to those of commercial boards, but they will not withstand frequent or continuous immersion in water.

66. Wingfield, B., Naffziger, T.R., Whittemore, E.R., Overman, C.B., Sweeney, O.R., and Acree, S.F.
Production of pressboard from cornstalks.
U.S. Natl. Bur. Standards, Misc. Publ. M 123, August 4, 1936. 10 p.

Studies have been made to find out the optimal conditions for producing pressboard from cornstalks. Cooking the stalks under pressure before fiberizing yielded stronger pulps than an exclusivly mechanical treatment did. Proper pressing conditions were 150°C and 500 lb./sq.in. The best sizing results were obtained by impregnation of the finished board; however, sizing in the beater is more economical.

Cotton stalks and cottonseed hulls

67. zur Burg, F.W.
Cotton stalks for synthetic lumber.
Paper Ind. 25, no. 6:612-15 (Sept., 1943).

The feasibility of utilizing cotton stalks as a raw material for building boards was studied. Pulping trials were made by cooking the chips in caustic soda under varying conditions or by beating them in a rod mill in the presence of water. The resulting pulp was formed into mats, pressed, and dried. The modulus of rupture of the boards varied from 80-500 lb./sq.in. A table with detailed cost items is presented.

68. Rosenthal, F.
Radio-frequency heat for farm waste plastics.
Pacific Plastics 3, no. 11:38 (Nov., 1945).

Laboratory experiments have shown the advantage of using radio--frequency heating for plastic materials, especially wallboards, from farm wastes. The material tested had a composition of 83 % cottonseed hulls and 17 % phenolic resin. No cleavage of the molded products was observed, which is in distinct contrast to check disks molded by contact heat alone.

69. Spencer, A.M., and Jacobson, A.
Fibrous board and sheet for insulation and other purposes of matted long cotton stalk fiber.
U.S. pat. 2,794,738 (June 4, 1957).

Paper and board are made from cotton stalk fiber by chopping the raw stalks into short lengths, cooking them in 0.1-0.5 % sodium hydroxide solution for 0.5-1.5 hr. at 20 psi. between 80 and 100°C, gently beating the cooked fibers, and passing them (still in the cooking liquor) to boardmaking machinery.

70. Spencer, A.M., Jacobson, A., and Sixt, K.
Method for fiber liberation in cotton stalks and the pulp.
U.S. pat. 2,668,110 (Feb. 2, 1954).

The chopped cotton stalks are cooked with a wetting agent and dilute alkali at 250-350°F for 5-15 min. using a special type of digester, and then disintegrated by nonabrasive beating. An asphaltic emulsion or the like may be added to the suspension. The stock is formed into wallboard, roofing paper, insulation, etc.

<u>Flax</u>

71. Derbentsau, F.F., Derbentsava, N.A., Kaplan, D.M., and Vladyka, L.I.
Manufacture of insulating building material from flax scutch.
Vestsi Akad. Navuk Beloruss. SSR. no. 1:55-62 (1952). (Russ.)

For the manufacture of insulating boards, the flax scutch was ground and chemically treated giving a material of low water and moisture absorbency.

72. Lüdtke, M.
The utilisation of the waste products from flax and hemp retting.
Melliand Textilber. 20, no. 4:253-6 (April, 1939). (Ger.)

The possibilities for utilising the waste products from flax and hemp retting are discussed. None of the industrial applications so far considered turned out to be practicable including the manufacture of insulating materials and fiberboards, and pulp and paper.

73. Mueller, M.E.
Insulation board.
U.S. pat. 2,608,492 (Aug. 26, 1952).

Hemp or flax shives from unretted plants are reduced in a beater at 125-150°F to the condition of a half stock. The pulp is formed into a sheet, pressed at 150-200°F and a pressure of 100-200 psi. and finally dried at 200-250°F. The resulting board can be used as a wallboard, for interior woodwork, or for heat insulation in a building.

74. Verbestel, J.
Structural board.
U.S. pat. 2,798,019 (July 2, 1957).

A high-strength, dimensionally stable, fungus resistant building board is formed by a dry process from fiber-free flax shives bonded with a resin, such as PF, and consolidated under heat and pressure.

75. Williams, T.I.
Waste converted into valuable products: new uses for linseed straw.
Indian Pulp and Paper 4, no. 1:20, 24 (July, 1949).

Among the products which can be made from flax straw are building board, insulating material, wrapping paper, etc.

76. Williamson, R.V., and Lathrop, E.C.
Hardboard from agricultural residues.
Mod. Plas. 28, no. 8:126, 128, 130, 187 (April, 1951).

(see abstract no. 12).

Hemp

77. Lüdtke, M.
The utilization of the waste products from flax and hemp retting.
Melliand Textilber. 20, no. 4:253-6 (April, 1939). (Ger.)

(see abstract no. 72).

78. Mueller, M.E.
Insulation board.
U.S. pat. 2,608,492 (Aug. 26, 1952).

(see abstract no. 73).

Mustard stalks

79. Hammer, H.
Experimental board manufacture with hitherto unevaluated fibrous substitutes.
Wochbl. Papierfabr. 77, no. 6:168-9 (1949). (Ger.)

(see abstract no. 3).

Papyrus

80. Barkworth, G.E., and Coomber, H.E.
Papyrus from Palestine.
Bull. Imp. Inst. 44, no. 4:279-86 (Oct.-Dec., 1946); Paper-Maker 114, no. 1:12, 14, 16 (July, 1947).

The authors examined papyrus from Palestine as a raw material for paper and board. The results of the experimental work indicate that the manufacture of boards for cartons and containers, or a board for building purposes is the most promising. A capacity of 2,500 t. of board per year may be sufficient to run the mill profitably.

Peanut shells

81. Modern Industry.
Low-cost products from the lowly peanut hull.
Modern Ind. 8, no. 6:48, 137 (Dec., 1944).

Building boards and other products can be made from peanut hulls by crushing them and binding the particles together with latex or other adhesives. The boards have considerable strengths and stiffness.

82. Williamson, R.V., and Lathrop, E.C.
Hardboard from agricultural residues.
Mod. Plas. 28, no. 8:126, 128, 130, 187 (April, 1951).

(see abstract no. 12).

Poppy straw

83. Hammer, H.
Experimental board manufacture with hitherto unevaluated fibrous substitutes.
Wochbl.Papierfabr. 77, no. 6:168-9 (1949). (Ger.)

(see abstract no. 3).

Rice husks

84. Nishi, T.
Wall-board composition.
Brit.pat. 239,437 (Feb. 17, 1925).

Rice husks are used with plaster, cement, lime, etc.

85. Williamson, R.V., and Lathrop, E.C.
Hardboard from agricultural residues.
Mod. Plas. 28, no. 8:126, 128, 130, 187 (April, 1951).

(see abstract no. 12).

Scrub palmetto

86. Modern Industry.
Scrub palmetto.
Modern Ind. 7, no. 1:38-9 (Jan., 1944).

The scrub palmetto has a loglike root which yields a pith and a fiber. The fiber is suggested to be used for brush bristles, upholstery stuffing, and twine, whereas the pith is a suitable material for insulating boards.

Straw

87. Abele, W.
Steamed straw for paper, board and building board.
Papier-Ztg. 62, no. 34:589-90 (April, 1937). (Ger.)

The moistened straw is steamed without the addition of chemicals, giving a yield of about 60 % in the case of rye, and 57 % in the case of wheat straw. The resulting pulp can be used for the manufacture of building board.

88. Aero Research Ltd.
The gluing of "Stramit" boards.
Aero Research Tech. Notes Bull. no. 113:1-4 (May, 1952).

The Stramit process for the manufacture of insulating-type building board from cereal straw is described. Unprocessed straw is compressed under heat into an endless slab and covered with strong paper liners.

89. Aronovsky, S.I., and Lathrop, E.C.
Pulp and paper research at the Northern Regional Research Laboratory.
Paper Mill News 75, no. 38:92, 94, 96, 126 (Sept., 1952).

A review is given of the work of the Pulp and Paper Section of the Agricultural Residues Division, including investigations on straw collection and procurement, preservation of straw in storage, and production of pulp and insulating board.

90. Bourgoin, L., and Belleville, L.
Investigations on pressed straw.
Rev. trimestr. can. 20:131-47 (1934).

Building boards of 0.25 in. thickness were made from untreated, water-soaked straw. Before pressing, an agglomerant consisting of casein, calcium hydroxide, starch or gluten, and lead arsenate was added and thoroughly mixed with the straw. The product showed a remarkably high fire resistance, good heat-insulating properties, and a better tensile strength than Celotex.

91. Dahl, E.
Machines for manufacturing boards from straw or like material.
Can. pat. 499,188 (Jan. 12, 1954).

A machine for making a continuous strip of insulating board with unprocessed straw or other long-fibered vegetable material as the filler and face sheets of paper, cardboard, or fabric is claimed. The straw is fed from a hopper and compressed between the forming platens by a reciprocating plunger.

92. Friedrich, K.
The behavior of fiberboard toward wood-destroying fungi.
Holz Roh- u. Werkstoff 4, no. 7:241-8 (July, 1941). (Ger.)

(see abstract no. 2).

93. Gibson, A.G.
Insulating board from straw.
Ind.Eng. Chem. 22, no. 3:223-6 (March, 1930).

A description is given of the plant of the Stewart Inso Board Co. which uses straw as a raw material for the manufacture of insulating boards similar to those made from wood waste or bagasse.

94. Lathrop, E.C., and Naffziger, T.R.
Evaluation of fibrous agricultural residues for structural building board products. I. Methods and equipment.
Paper Trade J. 127, no. 27:53-60 (Dec., 1948).

(see abstract no. 6).

95. Lathrop, E.C., and Naffziger, T.R.
Evaluation of fibrous agricultural residues for structural building board products. II. Fundamental studies on wheat straw fibers.
Tappi 32, no. 2:91-6 (Febr., 1949).

Methods are described for cooking and refining wheat straw to produce mainly long fibers and also hydrated short fibers. The relationship between fiber properties and physical characteristics of insulation boards made from them is thoroughly studied. Selected long straw fibers give boards of higher tensile and impact strengths than wood fibers. The results indicate that wheat straw is highly suitable for the manufacture of structural building boards.

96. Lathrop, E.C., and Naffziger, T.R.
Evaluation of fibrous agricultural residues for structural building board products. III. A process for the manufacture of high-grade products from wheat straw.
Tappi 32, no. 7:319-30 (July, 1949).

A process for the manufacture of high quality insulating building board from wheat straw is described in detail. The effect of operating variables on physical properties of the boards has been carefully studied. Two types of pulp are required: (1) unhydrated long-fibered pulp, and (2) hydrated pulp. The ratio of pulp types used in board manufacture greatly determines the physical characteristics of the finished products. Process equipment and economics are discussed.

97. Nielson, K.W.
Manufacture of insulating board from straw.
Ger. pat. 902,219 (Jan. 21, 1954). (Ger.)

Straw is chopped, pressed, cooked in alkaline solution, centrifuged, washed, refined, and, if molded boards are to be formed, recooked for a few minutes in a weak alkali solution prior to pressing and drying.

98. Oman, E.
Manufacture of fiberboard.
Ger. pat. 934,388 (Sept. 29, 1955). (Ger.)

Fiberboards are formed from a mixture of wood fibers and of straw fibers which have been decomposed in a calcium hydroxide solution.

The spent liquor from the cooking of the straw is added to the fiber mixture improving the hardness and strength properties of the board.

99. Schulze, B.
Comparative investigations of fiber building boards and other insulating materials with regard to their resistance to rots, molds, and insects. 1. Insulating wall boards.
Holz Roh- u. Werkstoff 3, no. 11:357-64 (Nov., 1940). (Ger.)

Methods for evaluating the resistance of fiber building boards and other insulating materials to the attack of rots, molds, and insects are described in detail. More than 35 products were tested, sometimes under rather drastic conditions. Mineral-bonded wood-wool boards were found to exhibit an excellent resistance to micro-organisms whereas strawboard was completely destroyed by fungi after a short time. Data are given in a tabulated form.

100. Schulze, B.
Comparative investigations of fiber building boards and other insulating materials with regard to their resistance to rots, molds, and insects. 2. Insulating panels and boards, flexible blankets.
Holz Roh- u. Werkstoff 3, no. 12:409-22 (Dec., 1940). (Ger.)

The description of the extensive investigations referred to in the previous abstract is continued. In addition to boards composed of wood fibers, some other insulating materials made from straw, cork or peat were tested. The results are tabulated.

101. Sheperd, E.S.
Building board.
U.S. pat. 1,891,732 (Dec. 20, 1932).

An improved building board is claimed which is made from cereal straws without any binders or gummy substances and which complies with all commercial requirements.

102. Stramit Boards, Ltd.
Straw and paper building board.
Paper Making and Paper Selling 67, no. 3:36 (Autumn, 1948).

In the Stramit process, straw is compressed at 150°C into a continuous slab without previous pulping. The slab is faced with paper on the front, back, and the two long edges and cut to the desired length. The resulting board is very rigid and has a high fire resistance, low thermal conductivity, and good acoustical properties.

103. Younger, J.O., and Aronovsky, S.I.
The physical evaluation of straw and other agricultural residue pulps.
Paper Mill News 68, no. 8:140-2 (Feb., 1945).

The proposed laboratory methods include disintegrating, washing and testing of cooked straw. It was possible to establish the relationship beween physical properties of handmade and machine-made straw pulps.

Tobacco waste

104. Hammer, H.
Experimental board manufacture with hitherto unevaluated fibrous substitutes.
Wochbl. Papierfabr.77, no. 6:168-9 (1949). (Ger.)

(see abstract no. 3).

105. McHargue, J.S., Woodmansee, C.W., and Rapp, K.E.
New uses for low-grade tobacco.
Chemurgic Digest 2, no. 15:130-2; no. 16:136-7 (Aug., 1943).

Low-grade Kentucky tobacco was used for making fiberboard by pressing the crude fiber. The product is hard and withstands nailing, sawing, and drilling as well as a wooden board.

Water hyacinth

106. Azam, M.A.
Utilization of water hyacinth in the manufacture of paper and pressed board.
Indian Print Paper 7, no. 3:41-4 (March, 1942).

The pulp obtained from water hyacinth (Eichhornia crassipes) by boiling in water with or without the addition of chemicals consists of very fine fibers. It can be used for special types of paper. When converting into pressed board, even better results are obtained. The products resembling Masonite boards are very tough.

B. MORPHOLOGICAL CHARACTERISTICS AND CHEMICAL COMPOSITION[1]

General

107. Kirby, R.H.
Vegetable fibres - botany, cultivation, and utilization.
New York, Interscience Publ., 1963. 464 p.

After an introduction into the occurrence, nature, identification, testing, chemical analysis, fineness, and commercial use of vegetable fibers (incl. bast and leaf fibers), various plant families are dealt with systematically (flax, lime, mallow, nettle, pea, sterculia, agave, narcissus, lily, pineapple, banana, bombax, milkweed, and miscellaneous families). Separate chapters deal with mechanized production of stem fibers, brush-making fibers, and papermaking fibers.

108. Nieschlag, H.J., Nelson, G.H., Wolff, I.A., and Perdue, R.E.jr.
A search for new fiber crops.
Tappi 43, no. 3:193-201 (March, 1960).

Data on the morphological and chemical characteristics of 58 plants, their density and yield after maceration are reported. The species investigated include bamboos, grasses, reeds, sorghum, and other gramineae, along with hardwoods representing 10 families. A scheme to evaluate the potential of the plants as a raw material for pulp and papermaking is suggested.

109. Singh, M.M., and Mukherjea, V.N.
Fibrous raw materials for the Indian pulp, paper, and board industry.
Indian Forester 91, no. 7:505-29 (1965).

For more than 50 years, the Forest Research Institute, Dehra Dun, has been testing indigenous fibrous raw materials for the production of pulp, paper, and board. Some of the results collected in the course of these investigations are presented in this article in a tabulated form, including data on fiber dimensions, chemical analyses, method of pulping, yield and uses of pulp. The following raw materials are covered: 11 bamboos, 18 grasses and reeds, 36 broadleaved woods and conifers, and 11 agricultural wastes. References are given.

110. Tamolang, F.N., Valbuena, R.R., Lomibao, B.A., Kalaw, C.L., Lindayen, T.M., and de Vela, B.C.
Fiber dimensions of certain Philippine woods, bamboos, agricultural crops and wastes, and grasses. III.
Tappi 43, no. 6:527-34 (June, 1960).

The fiber dimensions of eight bamboos, three agricultural crops

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[1] Additional data on the morphological characteristics and chemical composition of annual plants will be found in papers abstracted in sections C. and D.

(abaca, sisal, pineapple), two agricultural wastes (bagasse and rice straw), and two grasses were determined in addition to those of 47 Philippine hardwoods and two conifers. Average and extreme values are given.

111. Tamolang, F.N., Meniado, J.A., Phillips, E.A., Lindayen, C.K., Lindayen, T.M., and de Vela, B.C.
Fiber dimensions of certain Philippine woods, agricultural wastes and other plants. IV.
Tappi 45, no. 2:135-42 (Feb., 1962).

Data are given on the fiber dimensions and derived values of 4 agricultural and wild plants and 2 weeds along with those of 94 broad-leaved woods and 5 conifers. Pakol (Musa sp.) and torch ginger (Phaemeria excelsa Merr.) have fiber lengths comparable to those of softwoods.

112. Tamolang, F.N., Valbuena, R.R., Lindayen, C.K., Mamaril, F.M., Alonzo, D.S., and Lomibao, B.A.
Fiber dimensions of certain Philippine broadleaved and coniferous woods, palms, pandans, agricultural and ornamental plants. (Part V).
Tappi 49, no. 11:475-7 (Nov., 1966).

Studies were continued at the Philippine Forest Products Research Institute on the fiber dimensions of 2 palms, 2 pandans, 7 agricultural, and 3 ornamental plants, 192 broadleaved woods, and 5 conifers. Of the agricultural plants, banana (Musa sp.) leaf sheaths were found to have extremely long fibers (average fiber length of 4.8 mm).

<u>Abaca</u>

(see abstract no. 110)

<u>Bagasse</u>

(see also abstract no. 109; 110)

113. Isenberg, I.H., Knapp, S.B., and Wethern, J.D.
Sugarcane bagasse as a fibrous papermaking material. II. Cell dimensions of Hawaiian bagasse.
Tappi 40, no. 8: 597-601 (Aug., 1957).

In part II of this series on bagasse, data are given on cell distribution by type, cell dimensions, and amount of damage from sugar mill crushings. Average fiber length varies appreciably with variety of cane. The width of the nonfiber cells is four times that of the true fibers. Removal of the pith fraction is indicated for good strength development and pulp drainage.

114. Knapp, S.B.; Watt, R.A., and Wethern, J.D.
Sugarcane bagasse as a fibrous papermaking material. I. Chemical composition of Hawaiian bagasse.
Tappi 40, no. 8:595-7 (Aug., 1957).

Chemical analyses have been made on whole bagasse and on the pith and fiber fractions from four major varieties of Hawaiian cane. The results obtained were similar to those found for bagasse from other regions.

115. Pathak, J.R., and Srinivasan, V.R.
Studies on sugar-cane bagasse. Part II. Sorption studies and density data of bagasse and its fractions.
Indian Pulp Paper 13, no. 12:547-50 (June, 1959).

Bagasse as a whole shows a lower sorption ratio in water than other cellulosic materials. Its fractions (fiber and pith) exhibit a widely different sorption ratio, the fibrous portion being the more resistant one. The density values for the fiber are higher than those for the pith.

116. Rodriguez Jimenez, J.
Description of the physicochemical characteristics of bagasse.
Invest. Tec. Papel 8, no. [illegible]:449-59 (April, 1971). (Span.)

This review of the characteristics of bagasses covers sugar cane stem morphology and chemical composition of bagasse.

117. Villavicencio, E.J.
Continuous bagasse pulping.
Pulp Paper Intern. 5, no. 3:52-5 (March, 1963).

A new continuous process for high quality bagasse pulp is described. At the sugar mill, the bagasse must be partially depithed to avoid fiber damage during storage. Data on the chemical composition of Mexican bagasse and bagasse pith, and on the effect of sucrose fermentation are included.

Bamboo

(see also abstract no. 103; 109; 110)

118. Istas, J.R., and Raekelboom, E.L.
Biometric, chemical, and papermaking characteristics of Congolese bamboos.
Publ. Inst. Natl. Etude Agron. Congo, Ser. Tech. no. 67, 1962. 53 p. (Fr.)

The biometric, chemical, and papermaking characteristics are discussed in detail.

119. Istas, J.R.
Pulp from Congolese fibrous raw materials.
ECA/BTAO/FAO CONF/Paper II.a.4. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

This paper deals with the morphological, chemical, and papermaking characteristics of Congolese fibrous raw materials, both indigenous and exotic, including broadleaved woods, conifers, bamboos, and papyrus. Data are given in tabulated form.

120. Kitamura, H.
Studies on the physical properties of bamboo. 4. On the fiber content.
J. Japan Wood Res. Soc. 8, no. 6:249-52 (Dec., 1962). (Jap.)

Bamboo consists of fibrous vascular bundles and parenchymatous tissue. Fiber content decreases from the circumference to the inner part of the culm and becomes greater as the height of the culm increases. A variation of fiber content is not found, however, in different ages of culm.

121. Monsalud, M.R.
Fibre characteristics of bamboo species in the Philippines.
ECA/BTAO/FAO CONF/PAPER II.b.12. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

Studies on bamboo conducted at the Philippine Forest Research Institute showed that fiber dimensions varied considerably by species, e.g. fiber length from 1.36 to 3.78 mm. Additional information is given on fiber length distribution.

122. Nieschlag, H.J., Earle, F.R., Nelson, G.H., and Perdue, R.E.
A search for new fiber crops. II. Analytical evaluations, continued.
Tappi 43, no. 12:993-8 (Dec., 1960).

In a continuing search for plants that have potential as sources of raw material for papermaking, data are reported for 122 additional species in 22 plant families, including bamboos and other gramineae.

123. Young, R.A., and Haun, J.R.
Bamboo in the United States: Description, culture, and utilization - with key to the genera by F.A.McClure.
U.S. Dept. Agr., Agr. Research Serv., Crops Research Div., Agr. Handbook no. 193. Washington, U.S. Govt. Print. Off., June, 1961. 74 p.

This handbook covers the nature of bamboo growth, types of bamboo, generic key to bamboos cultivated in the USA and Puerto Rico, hardy running bamboos, tropical clump-type bamboos, cultural informations, harvesting and preparation for marketing, bamboo diseases and insect pests, and utilization.

<u>Banana</u>

(see abstract no. 112)

<u>Coconut</u>

124. Quadrat-I-Khuda, M., and Rahmatullah, M.
Studies on East Pakistan coconuts.
Pakistan J. Sci. Ind. Res. 2, no. 4:259-66 (Oct., 1959).

The fruit components (outer fibrous shell, inner hard shell, copra or kernel, and milk) of East Pakistan coconuts are discussed. The fibrous shell comprises from 25 to 50% of the weight of the fruit. The caustic soda cooking and bleaching of husk fibers yielded a colorless pulp.

Cornstalks

(see abstract no. 108)

Grasses

(see abstract no. 108; 109; 110)

Hemp

125. Ciba AG.
The hemp plant - cultivation, retting, mechanized preparation, and uses of hemp; prospects for hemp culture.
Ciba Rev. no 5:2-32 (1962).

This article treats all aspects of the hemp plant, its fibrous production, and uses of hemp.

Jute sticks

(see also abstract no. 109)

126. Tapadar, D.C.
Utilization of jute sticks for the manufacture of paper and board.
Ippta Souvenir no.: 137-41 (1964).

The supply of jute sticks in India is reviewed. Data cover chemical composition and fiber dimensions, showing jute sticks to compare closely with hardwoods. Suitable pulping processes and pulp characteristics are outlined.

Kenaf

127. Clark, T.F., Uhr, S.C., and Wolff, I.A.
A search for new fiber crops. X. Effect of plant maturity and location of growth on kenaf composition and pulping characteristics.
Tappi 50, no. 11:52-6A (Nov., 1967).

Kenaf in Northern Florida and Central Illinois was harvested at various stages of growth to compare effects of location and plant maturity on compositional and pulping characteristics. The results are presented in tabular form.

128. Clark, T.F., and Wolff I.A.
A search for new fiber crops. XI. Compositional characteristics of Illinois kenaf at several population densities and maturities.
Tappi 52, no. 11:2111-16 (Nov., 1969).

Physical composition, including fiber content and dimensional characteristics, and contents of selected chemical constituents were investigated for kenaf at several population densities and maturities. The results suggest that kenaf for pulp be grown to maximum maturity. Storage by letting it stand uncut in the field should be considered. Removal of tops and foliage should be at source.

129. Nieschlag, H.J., Nelson, G.H., and Wolff, I.A.
A search for new fiber crops. Part IV. Kenaf composition.
Tappi 44, no. 7:515-16 (July, 1961).

The chemical and morphological characteristics of kenaf (Hibiscus cannabinus) grown in different regions of the United States are presented.

130. White, G.A.
A search for new fiber plants. Part XII. Field yields of kenaf (Hibiscus cannabinus L.).
Tappi 52, no. 4:656-9 (April, 1969).

Yield potential and cultural requirements of kenaf are discussed. "Everglades 71" is the recommended variety yielding 8.6 tons/acre on a three-year average. Some other varieties also give good yields. The trials were conducted at various locations in the southern part of the United States.

131. Wilson, F.D.
Evaluation of kenaf, roselle, and related Hibiscus for fiber production.
Econ. Bot. 21, no. 2:132-9 (1967).

A survey was made on the bast fiber and dry matter content and fiber quality of both cultivated and wild strains of 13 spp. of Hibiscus, including kenaf (Hibiscus cannabinus), and roselle (H. sabdariffa).

<u>Pineapple</u>

(see abstract no. 110)

<u>Reeds</u>

(see also abstract no. 108; 109)

132. Iliescu, Gh.
The morphological structure of reed stalks.
Celulosa Hirtie 8, no. 9:275-80 (Sept., 1959). (Rom.)

The structure of reed stalks and its anatomical characteristics are described and compared with the morphology of other plant fibers. The influence of the complex structure of reed on its pulping and papermaking properties is discussed.

133. Ivanov, N.
Experimental results on the application of fertilizers to Italian reed.
Celuloza Hirtie 15, no. 9:339-43 (Sept., 1966). (Rom.)

Application of chemical fertilizers (N, P, K compounds) to reed cultures (Arundo donax) was shown to increase the yield of crops to 40-70 t/ha.

134. Krotkevich, P.G., and Podlipenskii, V.P.
Effect of flow control and irrigation on the species composition and quality of reed stands in the Dnieper delta.
Sb. Tr. Ukr. NII Tsellyul.-Bumazh. Prom. no. 11:9-24 (1968). (Russ.)

As a result of the construction of a hydroelectric plant in the lower Dnieper zone, the reed stands in the delta became dry during summer and contaminated with grasses and weeds. It was found that the deterioration of the quality of reed could be prevented by artificial irrigation of the stands from mid-April through July. To maintain the required water level, the stands should be protected by dikes.

135. Rozmarin, G., Solomon, B., and Simionescu, C.
The chemical composition of reeds.
Cellulose Chem. Technol. 1, no. 4:445-59 (July/Aug., 1967). (Russ.)

Two species of reeds (Phragmites communis and Arundo donax) were analyzed for their elementary composition, contents of cellulose, lignin, and hemicelluloses, of ash elements, and also by IR spectroscopy and thermography. The experimental data are presented in tables and graphs.

136. Rudescu, L.
Soviet advances in the biology, characterization, zoning, and agricultural management of reed.
Celulosa Hirtie 8, no. 11:349-57 (Nov., 1959). (Rom.)

Soviet research on reed cultivation and utilization is reviewed. 56 references.

137. Rudescu, L.
Methods for determining the biological and industrial productivity of reed in the Danubian Delta.
Celulosa Hirtie 11, no. 4:121-5 (April, 1962). (Rom.)

Methods of estimating the harvestable and technologically useful yields of reed-growing areas are outlined.

138. Rudescu, L., and Burova, T.
Influence of ecological conditions on the characteristics of reed from the Danube Delta.
Celulosa Hirtie 10, no. 7/8:243-8 (July/Aug., 1961). (Rom.)

The effect of soil and nutritional conditions on the yield, morphology, physical characteristics, and chemical composition of reed are discussed.

139. Rudescu, L., and Burova, T.S.
Effects of growth conditions on the characteristics of Danubian Delta reed.
Symposium on topical questions on the chemistry and technology of cellulose, Jassy, Sept. 24-27, 1961. Bucharest, Acad. of the Rom. Peoples Rep., 1963. p. 213-24. (Ger.)

The characteristics of reed from the Danube delta have been studied as a function of growing conditions.

140. Rudescu, L., and Popescu, J.
Comparative study of reed from climatically different countries. (1) Morphology. (2) Anatomy. (3) Ecology.
Celuloza Hirtie 15, no. 6:226-31; no. 11:425-[illegible]; no. 1[illegible]:455-7 (June, Nov., Dec., 19[illegible]). (Rom.)

Reeds (Phragmites communis and Ph. karka) from different climates are compared with regard to morphological and anatomical characteristics and ecological growth factors. The main requirement is some climatic excess which serves to induce a physiological rest period for several months. This is provided in Europe by winter frost, in Iraq and Egypt by prolonged drought, and in Pakistan by inundation. Growth-favoring chemical composition of soil and water are indicated.

141. Simionescu, C., and Rozmarin, G.
Chemistry of reed.
Bucharest, Editura Tehnica, 1966. 303 p. (Rom.)

This monograph deals with the cultivation, harvesting, morphology, anatomy, chemical composition, and pulping and papermaking technology of reed (Phragmites communis and Arundo donax). Each chapter is followed by an extensive bibliography.

142. Ulbricht, H.
Giant reed and common reed - a comparison of the anatomical, chemical, and technological properties.
Zellstoff Papier 15, no. 3:74-7 (March, 1966). (Ger.)

Giant reed (Phragmites communis subsp. pseudodonax) is taller than the common reed (Ph. communis), and has a stem which comprises a greater portion of the total plant. It also has a higher portion of sclerenchymatic tissue. Some further differences in anatomical structure, chemical composition, and technological properties have been noticed.

<u>Sisal</u>

(see abstract no. 110)

<u>Sorghum</u>

(see also abstract no. 108)

143. Escourrou, R.
Paper sorghum.
Papeterie 82, no. 1:29-33, 35, 37 (Jan., 1960). (Fr.)

The author discusses the cultivation of paper sorghum, its morphology, and the papermaking qualities of its fibers. Compared to other annual plants and many wood species, sorghum is said to be the most easily cultivated and to give relatively high yields (20 tons cellulose/ha). The properties of sorghum fibers are comparable to those of bagasse fibers.

144. Lengyel, P., Péteri, K., and Tomek, A.
Domestic plants suitable for pulp manufacture. IV.
Papiripar 4, no. 3:100-5 (1960). (Hung.)

The morphology and chemical composition of sorghum are described. Pulping trials indicated this fiber to be suitable for pulp and papermaking.

Straw

(see abstract no. 109; 110)

Tobacco

(see also abstract no. 109; 111)

145. Kimura, Y., and Teratani, F.
Studies on the manufacture of tobacco stem pulp. 1. Fibers and chemical composition of tobacco stem.
J. Jap. Tappi 16, no. 11:894-900 (Nov., 1962). (Jap.)

According to investigations carried out by the authors, the waste stems of a native Japanese tobacco plant comprise ca. 12 % of root tissue, 64 % of woody tissue, 16 % of bast, and 8 % of pith. The woody stem portion generally comprises 10 % of vessels, 19 % of ray cells, and 71 % of wood fibers. The main type of tobacco fiber is slightly finer and thinner-walled than the common hardwood fiber. Chemical analysis showed that the composition of the woody part of the stem was roughly the same as that of hardwood, except that the tobacco xylem abounded in pectin. It is concluded that tobacco plant residues can possibly be utilized as a raw material for pulp.

Water hyacinth

(see abstract no. 111)

C. TECHNICAL AND ECONOMIC ASPECTS RELATED TO HARVESTING, TRANSPORTATION, STORAGE AND PRE-PROCESSING

General

146. Atchison, J.E.
Progress in preparation and pulping of agricultural fibers.
Indian Pulp Paper 17, no. 12:681-9, 694 (June, 1963); 18, no. 2:159-61, 163-5, 167-8, 17[illegible] (Aug., 1963).

These articles include: preparation of agricultural fibers before digestion; collection, storage, and preservation of bulky agricultural fibers. Further headings are: new mills in operation, under construction or being developed for utilizing agricultural fibers, and expanding use of pulp produced from agricultural fibers and fast-growing long-fibered plants.

147. Birdseye, C.
Process for storing and digesting of fibrous agricultural residues.
U.S. pat. 2,899,350 (Aug. 11, 1959).

A method for storing shredded bamboo, straw, bagasse, and other agricultural residues involves impregnating the baled or piled material with sodium hydroxide and effecting a certain amount (ca. 20%) of digestion without decay. Prior to storage, the material may be sterilized by heating it to at least 80°C. After 9-12 months the material is treated with kraft white liquor, subjected to a steam pressure of 150 psi and a temperature of ca. 185°C for 5 min before being exploded through a suitable valve.

148. Lathrop, E.C., Naffziger, T.R., and Mahon, H.I.
Methods for separating pith-bearing plants into fiber and pith.
U.S. Department of Agriculture, Bull. ARS-71-4 (March, 1955).

A thorough study of depithing methods has been made at the Northern Research and Development Division, Peoria, Ill., and several practical and economical methods for effecting the needed separation into fiber and pith have been developed.

149. Stanford Research Institute.
The economic availability of fibrous raw materials in India, Burma, and Thailand.
Pulp and Paper Prospects in Asia and the Far East. Vol. II, p. 27-113. UN/FAO. Bangkok, 1962.

The primary objective of this study was to determine the delivered cost of alternative fibrous pulping materials to selected pulp mill sites in the states of Madras and Uttar Pradesh, India, and in Burma and Thailand. The methods of evaluation developed by the Stanford Research Institute can be applied, however, anywhere in developing countries. Supply, extraction or harvesting cost, collection cost, and transportation cost are considered along with other cost elements such as overhead, insurance, and interest. The main emphasis is on agricultural residues and other non-wood materials, incl. bagasse, bamboo, rice straw, and some grasses. The methods used in the different countries for harvesting, collection, baling, storage, etc., are briefly described.

150. TAPPI Non-Wood Plant Fibers Committee.
Non-wood plant fiber pulping. Progress report No. 2.
Tappi C.A. Report no. 40: 333 p. (1971).

This progress report contains 10 separate contributions covering new methods of handling and storage of non-wood plant fibers (bagasse, straw, bamboo, reed, and grasses). The various papers are abstracted individually in this bibliography.

Bagasse

151. Atchison, J.E.
Bagasse becoming a major raw material for manufacture of pulp and paper - background, present status, and future possibilities.
Proc. Intern. Soc. Sugar-Cane Technologists 11:11[illegible]-1[illegible](19[illegible]).

This report includes: a historical review of the utilization of bagasse; present utilization of bagasse; purchase, collection storage, and preservation of bagasse; preparation for pulping; and processes and equipment used for pulping bagasse. A list of mills in operation or under construction for utilizing bagasse is appended.

152. Atchison, J.E.
Utilization of bagasse for manufacture of pulp, paper and board.
Indian Pulp Paper 17, no. 1: 37-41, 46 (July, 1962).

The recent history of pulp, paper and board manufacture from sugar--cane bagasse is presented. Methods of bagasse collection, storage, preservation, depithing, and pulp processing are outlined.

153. Atchison, J.E.
Progress in preparation and rapid continuous pulping of agricultural fibres.
Pulp and Paper Prospects in Asia and the Far East. Vol. II, p. 431-43. UN/FAO. Bangkok, 1962.

Before entering into the description of the rapid continuous pulping of agricultural residues, the author reviews the various methods of cleaning straw and of depithing bagasse. Both wet and dry methods have been developed and used successfully. As to bagasse, a two-stage depithing system is suggested, involving a partial pith separation in a humid condition followed by wet depithing. Simplified flow diagrams are given.

154. Atchison, J.E.
Progress in the utilization of bagasse as a raw material for pulp and paper manufacture.
Ippta Souvenir no.: 52-63 (1964).

The availability and utilization of bagasse as a papermaking raw material are discussed, including bagasse purchase, collection, storage, and depithing (especially humid and wet depithing).

155. Atchison, J.E.
Experiences in developing, building and operating bagasse pulp and paper mills.
ECA/BTAO/FAO CONF/Paper II.b.7. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

The experiences gained in the development, construction and operation of five bagasse pulp and paper mills are presented. Methods of handling, storage and depithing bagasse are described and illustrated by flow sheets. It is pointed out that the most efficient methods of depithing usually involve a two-stage process.

156. Atchison, J.E.
Rapid gains in use of bagasse for manufacture of pulp and paper.
Indian Pulp Paper 23, no. 1:131, 133-9 (July, 1968).

The availability of bagasse is discussed as well as its purchase, collection, storage, and preservation. Emphasis is placed on bagasse depithing and proper preparation for pulping. Processes used in pulping bagasse are described. The greatest single cost factor is the cost of alternate fuel.

157. Atchison, J.E.
Modern methods of bagasse depithing: the key to large-scale utilization of bagasse for manufacture of pulp, paper, and board.
Tappi C.A. Report no. 34 (Nonwood fiber pulping. A progress report): 21-90 (1970).

An extensive review is given of bagasse depithing methods, including the history of depithing; newly developed techniques; aspects to be considered prior to selection of the depithing method and equipment; and the effect of depithing on pulp properties.

158. Atchison, J.E.
Modern methods of purchasing, handling, storage and preservation of bagasse. Major advances in the sixties.
Tappi C.A. Report no. 40 (Non-wood plant fiber pulping. Progress report no. 2): 1-49 (1971).

New developments in purchasing, handling, storage, and preservation of bagasse are discussed. Because of favorable economics, both the sugar factories and the pulp mills agree on removing as much pith as possible at the sugar mill returning it to the boilers as fuel. Newly developed storage methods include wet bulk storage with or without biological pretreatment; moist bulk storage direct from the sugar mill without any treatment; dry storage in dense pads under cover after artificial drying; and storage in dry briquettes or pellets. The newer bulk storage methods have advantages over the classical bale methods and find increasing application.

159. Biagiotti, P.
Methods for bagasse storage.
Peadco 4th Intern. Forum (Torremolinos, Sept. 19-22, 1971). 13 p.

The advantages and disadvantages of available bagasse storage methods, and their economics are discussed. Since a universally valid method is unknown, a method-evaluation procedure is suggested prior to actual selection and installation at any specific bagasse-processing plant.

160. Bonvich, G., Dubrocq, D., and Mesa, A.
Microscopic study of bagasse.
Cuba Azuc. Oct./Dec., 1969: 32-7, 57-61.

The effect of the method of processing bagasse in a chopping mill on its components was investigated microscopically. Data are given on the percentage of whole fibers, disrupted fibers, and nonfibrous particles to be found in the different samples, and on the dimensions of the fibers and nonfibrous elements. All data are analyzed statistically.

161. Broomhall, W.M.
Bagasse difficulties between the sugar mill and the stuff chest and how they have been overcome.
Peadco 4th Intern. Forum (Torremolinos, Sept. 19-22, 1971).
12 p.

Problems peculiar to bagasse as a papermaking material are described, incl. those encountered in storage, depithing, liquor impregnation, and pulping.

162. Buechner, H.A.
Bagassosis - a medical enigma.
J. Louisiana State Med.Soc. 112, no. 2:58-61 (Feb., 1960).

This respiratory illness is a serious occupational hazard resulting from exposure to bagasse dust. Various explanations of the disease have been presented, however, the precise physiopathological mechanism remains obscure.

163. Cellulose Development Corporation Ltd. and John Thompson Water Tube Boilers Ltd.
Saving of bagasse for papermaking - thermal considerations.
Pulp and Paper Prospects in Latin America. Second Part, p. 325-33. UN/FAO. New York, 1955.

The purpose of this paper is to suggest means to liberate bagasse for pulp and papermaking at those sugar mills where bagasse is used as a fuel and little or no surplus exists. Release without using an alternative fuel as well as release by substitution are considered.

164. Chapman, A.W.
Purchasing, handling and storing of bagasse.
Pulp and Paper Prospects in Latin America. Second Part, p. 335-7. UN/FAO. New York, 1955.

The standard operating procedures and techniques developed by the Celotex Corporation for handling the large amount of bagasse needed are described. The material must be baled and stored within a period of approximately seventy-five sugar-mill operating days. Some of the difficulties encountered during development of the current procedures are pointed out.

165. Chapman, A.W.
Purchasing, handling and storing of bagasse.
FAO/ECE/BOARD CONS/Paper 4.12. Consultation on Insulation Board, Hardboard and Particle Board. Geneva, 1957.

The American practice of purchasing, storing and handling bagasse, and the layout and equipment required are described in detail. Mechanization of harvesting sugar cane may adversely affect its use in board manufacture since mechanically harvested bagasse contains a larger percentage of leaves and other debris than that harvested by hand.

166. Chou, W.W.Y.
Twenty-five years industrial experience in the manufacture of pulp from bagasse.
ECA/BTAO/FAO CONF/Paper II.b.4. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

The utilization of bagasse as a raw material for pulp and paper manufacture is briefly discussed including storage and depithing problems.

167. Cusi, D.S.
Commercial experience in the depithing and fibre fractionation of bagasse.
ECA/BTAO/FAO/Paper II.b.3. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

The first section of this paper deals with the structure of bagasse, its cellular morphology, and the effect of storage on chemical and physical properties. After that, the different aspects of depithing bagasse are discussed in detail.

168. Cusi, D.S., and Jolley, P.W.R.
How bagasse is pulped by method used in Mexico.
Pulp Paper Intern. 10, no. 6:56-9 (June, 1968).

The Simon-Cusi multi-step pulping method is used at the world's largest bagasse pulp mill. All steps in the process, including storage of baled bagasse, and both wet depithing and a cheaper alternative moist process are described. After natural drying, the bales can be stored in high stacks for three years or more without appreciable deterioration or darkening.

169. Glomera Ltd.
Glomera complete process of preparing and briquetting sugar cane bagasse.
Basel, Switzerland, Glomera Ltd., Pamphlet no. 104A (no.date). 9 p.

This process produces long (10-50 mm) dry depithed fibers of high quality from raw bagasse and compresses the fibers into briquettes. The fibers are suitable for the manufacture of hardboard, insulating board, chemical and mechanical pulp for paper, etc. Diagrams of the necessary equipment and of the briquetting device, and a flow chart of such a plant are appended.

170. Gremler, H.
Preparation of bagasse as a pulp raw material.
Bol. ABCP 2, no. 11:10-18 (March, 1969). (Port.)

Methods and equipment used in dry and wet depithing, and preservation of bagasse are reviewed in some detail.

171. Gundo Rao, S.N., and Sharma, J.C.
Various considerations for releasing bagasse from sugar factories for the manufacture of paper pulp.
Ippta 7, no. 4: 311-14 (Oct./Dec., 1970).
The sugar industry could release some bagasse for the pulp and paper industry if it improved its steam generation efficiency by working at higher pressures or if it reduced the steam requirement of the manufacturing process. It might also change completely to coal or oil.

172. Höpner, T.
Preservation and storage of bagasse according to E.A. Ritter's method.
Papier 18, no. 5:204-6 (May, 1964). (Ger.)

This article deals with the biological preservation of moist bagasse following a method devised by Ritter in S. Africa nearly 20 years ago. After treatment with a special biological liquor, bagasse can be stored for a long time without appreciable deterioration. The enzymatical degradation of low-molecular components (sugars) is supposed to improve the quality of bagasse rather than to impair it.

173. Kamel, H., and Sundelin, A.
The use of sugarcane bagasse for pulp and paper production in the United Arab Republic.
ECA/BTAO/FAO CONF/Paper II.b.5. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

In section 4 of this paper, the methods and cost of baling, storage and depithing of bagasse are discussed. The machines, number of workers, amount of electric power, etc., required in these operations, are specified in annexed tables.

174. Keller, A.G.
A review of methods for depithing sugar cane bagasse.
ECA/BTAO/FAO CONF/Paper II.b.2. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

The principles and most common methods for depithing bagasse are outlined.

175. Knapp, S.B., and Henderson, J.T.
Paper manufacture from bagasse.
Ippta Souvenir no.: 66-75 (1964).

Bagasse storage techniques and depithing procedures are discussed along with bagasse pulping processes.

176. [illegible], [illegible]
Economic and other factors to be considered in the use of sugar cane bagasse as a raw material for pulp and paper manufacture.
Pulp and Paper Prospects in Latin America. Second Part, p. 314-25. UN/FAO. New York, 1955.

The physical, chemical and pulping characteristics of bagasse vary to some extent due to cane culture and cane-harvesting practices, and to milling practices. Since baling, storing, and handling bagasse are expensive operations, every effort must be made to eliminate unnecessary work. A review of suitable storing methods developed and used at various mills is given. Finally, the pros and cons of dry and wet depithing are discussed in some detail, including operating cost.

177. McCloskey, J.T.
Determination of fiber and pith in bagasse.
Peadco 4th Intern. Forum (Torremolinos, Sept. 19-22, 1971). 29 p.

A newly developed method is presented which provides for rapid complete separation of fiber and pith with minimal errors due to sample weighing and fiber cutting. It works equally well with whole bagasse, depithed fiber, or pith.

178. MacDonald, T.
Ritter bagasse process.
Pulp Paper Intern 5, no. 10:45-7 (Sept., 1963).

The Ritter process consists of a method for the pretreatment, storage and preservation of bagasse. Through the biological pretreatment, the separation of the pith is facilitated. Storage is carried out in bulk form. The menace of fire hazard is completely eliminated.

179. Misra, D.K.
Comparative study of bagasse and wheat straw for pulp and papermaking.
Tappi C.A. Report no. 40 (Non-wood fiber pulping. Progress report no. 2): 51-87 (1971).

A detailed discussion is presented of similarities and differences in the behavior of bagasse vs. wheat straw during harvesting, collection, baling, transport, raw material preparation (depithing, dusting, cutting, cleaning, etc.), pulping, and papermaking.

180. Möbius, J.
The storage and preservation of bagasse in bulk form without baling.
ECA/BTAO/FAO CONF/Paper II.b.1. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

An illustrated description of the Ritter process for storing bagasse in bulk form is presented. The process permits the storage of large amounts of bagasse on a relatively small area. Further advantages are the prevention of any fire hazard and decay, and the elimination of baling.

181. Mora, M.M.
The effect of storage on the yield and quality of semi-chemical bagasse pulp.
Ph.D. Thesis. Louisiana State Univ., 1962. 107 p.

The degree of bagasse deterioration during unprotected storage was found to diminish with increasing amounts of pith removal and with decreasing original moisture content of the stored fiber. The least deterioration **occurred** on wet depithed fiber stored with an original moisture content of less than 20 %. The effect of storage on the economics of bagasse as a raw material for pulp and paper was studied.

182. Mora, M.M., and Keller, A.G.
The effect of mechanical depithing on yield and quality of semi-chemical bagasse pulps.
Pulp and Paper Prospects in Asia and the Far East. Vol. II, p. 397-404. UN/FAO. Bangkok, 1962.

A major problem in **connexion** with the use of bagasse for pulp and papermaking is the cost of handling and processing the raw material prior to pulping. The most common methods for storage, preservation and depithing are briefly described before studying the effect of dry and wet depithing on yield and quality of semi-chemical pulps.

183. Nolan, W.J.
Processing bagasse for paper and structural board.
Tappi 50, no. 9:127-36A (Sept., 1967).

A depithing procedure is described, consisting of decortication of bagasse in an attrition mill at 20 % consistency, followed by washing pith and fines from the fiber on a travelling screen belt. Short fiber is recovered from tailings, resulting in an overall fiber yield of 70 % of whole bagasse. Possible uses of pith are discussed. A rapid laboratory method for evaluating the pith and fines fraction in bagasse is presented. Further sections of the study deal with kraft pulping of depithed and undepithed bagasse, and with the production and properties of wallboard and hardboard from depithed bagasse fiber (see section D. of this bibliography).

184. Podder, V.
Review of pulping methods for bagasse.
Pulp and Paper Prospects in Asia and the Far East. Vol. II, p. 423-30. UN/FAO. Bangkok, 1962.

The various processes for depithing, cleaning, baling, and storage of bagasse are outlined, including more recent developments. The rest of the paper deals with pulping problems.

185. Rangan, S.G.
Bagasse pulping in Latin America.
Indian Pulp Paper 21, no. 6:391-7, 400-2 (Dec., 1966).

The author describes the Peadco, Cusi, and Ayotla processes of bagasse handling and pulping, incl. stacking of bales, depithing, pith disposal, cooking, pulp washing, and screening.

186. Rangan, S.G.
Commercial aspects of bagasse; procurement, storage, and fuel substitution problems.
Ippta 7, no. 4: 305-8 (Oct./Dec., 1970).

Presently, the greater part of bagasse produced at Indian sugar mills is used as fuel. Suggestions are made as to how considerable amounts of bagasse can be released for the manufacture of pulp and paper, e.g. by moderating the steam consumption at the sugar mills. The cost of substituting fuel oil are also discussed.

187. Ranwez, G.
Saving of bagasse by improved boiler-house operations.
Pulp and Paper Prospects in Latin America. Second Part, p. 333-5. UN/FAO. New York, 1955.

The efficiency of existing steam generating installations in sugar mills can be improved considerably at a fairly low cost. This not only eliminates the need for using wood or oil as a supplementary fuel, it also releases considerable amounts of bagasse for pulp and papermaking.

188. Ritter, E.A.
Process for the treatment of cellulosic materials.
U.S. pat. 2,960,444 (Nov. 15, 1960).

Cellulosic materials (e.g. bagasse, wood chips, etc.) are impregnated with water containing cultures of Lactobacilli and allowed to ferment. The treatment is of use in preserving the cellulosic material, and for predigesting the material.

189. Rodriguez Jimenez, J.
Handling of bagasse.
Invest. Tec. Papel 8, no. 29: 799-823 (July, 1971). (Span.)

The properties of bagasse are influenced by many factors, particularly by the procedure used in bagasse storage (storage in natural or artificially dried condition). Artificial drying prior to storage results in high-quality bagasse.

190. Salabar, J., and Masa, F.
Ritter biological treatment process for bagasse bulk storage.
Tappi C.A. Report no. 40 (Non-wood fiber pulping. Progress report no. 2): 89-136 (1971).

In the Ritter process, as practised at the Ledesma bagasse mill in Buenos Aires, moist depithed bagasse is discharged into an overhead channel which is fed continuously with a biological liquor containing lactic acid bacteria cultivated in 2.5% molasses solution. The diluted fiber flows to a travelling crane moving on rails along the sides of a concrete storage slab onto which the suspension is dumped by free fall. Advantages of Ritter-stored bagasse over untreated fresh bagasse are discussed.

191. Sandwell & Co. Ltd.
A review of bagasse technology for pulp and paper production.
FAO Document no. 12,39 (March, 1970). 62 p. (Span.)

This extensive review covers the following subjects: properties of bagasse (fiber dimensions, chemical composition); depithing methods; baled storage and bulk storage methods, incl. the use of preservatives; pulping methods; the value of bagasse as a fuel; and the properties and uses of pulps and papers made from bagasse.

192. Schmidt, J.G.A.
The current status of bagasse as a pulp and paper raw material.
Allg. Papier-Rundschau no. 20: 1306, 1308, 1310; no. 21:1400, 1402, 1404; no. 22: 1462, 1464, 1466; no. 23: 1527-8; no. 24: 1588-90 (Oct., Nov., Dec., 1965); no. 5:133-4 (Feb., 1966). (Ger.)

This series includes a review of data on bagasse fiber morphology and physical and chemical properties, comminution techniques, mechanical and biological depithing processes, storage procedures, and cooking methods. A list of known bagasse pulp and paper mills throughout the world is appended.

193. Wilson, A.W.
Bagasse pulping in remote Argentina.
Pulp Paper Intern. 13, no. 2:50-2 (Febr., 1971).

The Ledesma pulp and paper mill in Argentina has been using the Ritter bagasse bulk storage system for several years. The process permits bulk storage of moist bagasse for five years or even more without any deterioration. Another feature of the mill is its modern black liquor recovery system.

194. Wilson, A.W.
Bagasse developments - Storage methods, fire hazards, continuous cooking discussed.
Pulp Paper Intern. 14, no. 2: 51-3 (Febr., 1972).

In this second report on the 1971 Peadco conference, three main subjects covered were bale versus bulk storage of bagasse, control of fire hazards in bagasse piles, and centrifugal wet depithing of bagasse.

195. World's Paper Trade Review; International Paperboard Industry.
Stabilizing micro-organisms in bagasse.
Intern. Pbd. Ind. 13, no. 6:26-7 (June, 1970).

Addition of a small amount of propionic acid to bagasse effectively prevents deterioration in storage from fungi and bacteria, and protects the laborers from contracting the respiratory disease known as bagassosis.

195/1 Bernhardt, D.R.
Bulk storage of bagasse.
Sugar J. 30, no. 10: 36-7 (March, 1968).

The Valentine Pulp and Paper Co., Louisiana, has developed a method of storage, in which the freshly milled bagasse is stacked in large circular piles without any pretreatment. The piles are up to 20 m high and contain 15,000 to 20,000 tons of bagasse (moisture-free basis). It is reported that the outside layer of these stacks suffers rather severe damage, but it then forms a protective shell for the remainder of the pile. The advantages of this system in comparison to baled storage methods include reduction of handling and transportation cost, elimination of fire hazard, improvement of pulp quality, higher pulp yield, etc.

195/2 Payne, J.H.
New developments in handling and storage of bagasse.
Ind. Agr.Res. Management Newsletter 9, no. 2:3 (1969).

The method of pneumatic conveying of bagasse has certain advantages as compared to more common systems. When using a pipe-line of 25 cm diameter, about 75 tons of bagasse can be conveyed per hour. Fire hazard and evolution of dust are at a minimum. Costs of handling and maintenance are reduced considerably. Another new development is the bulk storage of dry bagasse which is reported to be simpler and more economic than the Ritter method.

195/3 Tantawi, M.H.
Technical and economic aspects of bagasse utilization.
ID/WG.83/9. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 19 p.

The author discusses various problems relating to the transportation, storage, and pre-processing of bagasse, in particular considering the methods used at paper and board mills in Egypt. If bagasse is to be processed into particle board, it should be depithed and pre-dried. Moist depithing and natural drying are felt to be the most appropriate methods. In the production of hardboard, a wet bulk-storage method is preferable. Baling systems for the storage of bagasse are expensive and require careful stacking and the provision of spaces between the bales to prevent discoloration and decay.

Bamboo

196. Aung, U.M., and Fleury, J.M.
Breakthrough in bamboo pulping.
Pulp Paper Intern. 2, no. 5:21-? (May, 1960).

Shredded bamboo has shown distinct advantage over chipped in the production of kraft pulp and hardboard. The shredder developed at the institute in Rangoon tears the long fibers from the bamboo culm along its natural axis and eliminates most of the undesirable waste material and silica. For the production of hardboard, no binder or chemicals are required.

197. Jangalgi, N.R., Jauhari, M.B., Agarwal, R.D., Jaspal, N.S., and Bhargava, R.L.
Improved yield at the west coast paper mills (India).
Ippta 6, no. 2:17-23 (April/June, 1969).

At the west coast paper mills in India, appreciable improvements in utilizing bamboo for pulp and papermaking have been established such as the use of statistical techniques for measuring the quantity of incoming bamboo, proper methods for stacking and preservation, and especially chipping with minimum dust loss. A description is also given of the use of bamboo dust.

198. Meier, H.
Technical and economic experience in the harvesting and transportation of bamboo for pulp and paper manufacture.
ECA/BTAO/FAO CONF/Paper II.b.9. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

At the Karnaphuli Paper Mill, East Pakistan, the extraction of bamboo from the jungle has been mechanized, using ropeways, tractors and trailers for transporting the bulky material to riverside collecting centres. The experiences gained during some years of operation are presented.

199. de la Mensbruge, G.
Planting methods and costs of producing bamboo for pulp and paper manufacture.
ECA/BTAO/FAO CONF/Paper II.b.8. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

Studies have been made in the region of Abidjan to determine the most efficient method of planting bamboo. A rough estimate is given of the planting cost and the cost of harvesting and transportation. It follows from the study that a pulp mill could operate under favourable conditions when using bamboo as a raw material.

200. Mokhasi, S.G., Handigol, S.G., Jaspal, N.S., and Bhargava, R.L.
Outside chip storage of Bambusa arundinacea.
Ippta 6, no. 4:7-17 (Oct./Dec., 1969).

The effects of outside chip storage on the chemical composition of bamboo, its pulping characteristics and papermaking properties were extensively studied. The values were compared with those for bamboo stacks showing only very few differences. From an economic standpoint the handling of the chips proved more effective, and showed savings of 30-35 % over the handling of the stacks.

201. Palmer, A.
Problems and solutions in chipping bamboo for pulping.
Indian Pulp Paper 20, no. 4:271-2, 276 (Oct., 1965).

Feedworks for conveying, charging, and crushing bamboo sticks, as well as the chippers themselves, pose special design problems, owing partly to wide differences in stick dimensions and partly to the abrasive properties of bamboo. Small sticks should be collected into bundles of 10-12 inch diameter, whereas thicker sticks are best fed individually. With proper design and operation, more than 90% of acceptable chips can be obtained after screening.

202. Ono, K.
Studies on bamboo pulp industry. (1) Bamboo forest resources in Indonesia and Burma.
Japan Pulp Paper 3, no. 2:62-9 (June, 1965).

Data are presented on the geographic distribution, types, utilization (incl. uses other than for pulp), cost of harvesting, total resources, etc.

203. Ono, K.
Studies on bamboo pulp industry. (2) Scientific techniques of bamboo pulp industry.
Japan Pulp Paper 3, no. 3:54-63 (Sept., 1965).

Topics discussed include the morphological and chemical properties of bamboo and its fibers; handling and chipping of bamboo; pulp manufacture from bamboo and bleaching of the pulp; papermaking techniques, etc.

204. Vladut, R., and Boiciuc, M.
Aspects of bamboo stem utilization in Roumania.
Ind. Lemnului 20, no. 5: 178-81 (May, 1969). (Rom.)

The papermaking characteristics and related properties (such as fiber length, silica content, etc.) of various bamboo spp. are reviewed along with problems of cultivation, harvesting, handling, and processing.

Cornstalks and corncobs

205. Paper Trade Journal
American-Israeli mill expansion includes bleached cornstalk pulp.
Paper Trade J. 144, no. 27:22-6 (July, 1960).

The handling, baling and storage of cornstalks and straw, and the cooking and bleaching process used at the paper mill of Hadera, Israel, are described.

206. Popescu, G., and Banciu, I.
Papermaking trials with corncobs. (1) Morphology and storage.
Celuloza Hîrtie 16, no. 6:193-200 (June, 1967). (Rom.)

Corncobs differ from other annual plants by having abundant parenchyma tissue or medulary parenchyma. In small and medium-size piles, corncobs can be stored up to 12 months without appreciable deterioration, except at the base of the piles in direct contact with the ground. As to the storage in large commercial piles, no data are available so far.

Cotton stalks

207. Minina, V.S., Usmanov, Kh.U., and Hunova, L. [illegible].
Changes in the chemical composition of cotton plant stems during prolonged storage.
Gidroliz. Lesokhim. Prom. 16, no. 8:15-16 (1963). (Russ.)

Chemical and microbiological analyses were made of cotton stems stored outdoors in the form of piles for about a year, and having various moisture contents. At the beginning of the storage period when the moisture content was high, a rapid growth of various micro-organisms (fungi and bacteria) could be observed, but with gradual drying the number of micro-organisms diminished. At a moisture content of 20 %, their growth was inhibited. There were no significant changes in the chemical composition of the cotton stems. The maximum loss of dry substance of the stems was 7.5 %, and occurred mainly in the lower layers of the piles.

Flax and hemp

208. Venturi, G.
Comparison of hemp harvesting methods. I. Product for textile use. II. Product for papermaking use.
Ind. Carta 7, no. 12:514-20; 8, no. 1:8-18 (Dec., 1969; Jan., 1970). (Ital.)

In 1965 and 1967 experiments were conducted with Italian hemp varieties cultivated exclusively for papermaking. The cultivation procedures and harvesting methods are described and compared with those applied to hemp for textile use.

Grasses

209. Bhargava, R.P.
Industrial experience in the pulping of grasses in India.
Pulp and Paper Prospects in Asia and the Far East. Vol. II, p. 444-51. UN/FAO. Bangkok, 1962.

The utilisation of sabai grass for pulp and papermaking is discussed including the methods used in storage, cleaning, dusting, and cutting.

210. [illegible]owes, F.C., and [illegible]
Spontaneous heating and ignition in esparto grass.
World's Paper Trade Rev. 156, no. 7:572, 574, 576 (Aug., 1961).

It is shown that moist esparto grass can undergo spontaneous heating with the risk of ignition in the same way as other moist vegetable materials. For that reason, stacks of esparto showing signs of heating should be dismantled and allowed to cool or should be processed immediately.

211. Grant, J.
The economics of esparto grass as a raw material for the manufacture of paper pulp.
ECA/BTAO/FAO CONF/Paper II.b.15. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

The methods of collection, transportation, and storage of esparto grass as practised in North Africa are described, and cost estimates of these operations are given. The labor cost could be reduced considerably, if mechanical harvesting methods were used. Finally the properties and uses of the paper pulp made from esparto grass are discussed.

212. La Rochette Cenpa.
The harvesting, collection and transportation of esparto grass in Algeria.
ECA/BTAO/FAO CONF/Paper II.b.14. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

Description of the operations specified in the heading. Since the harvesting costs are high, the utilization of esparto grass for pulp and papermaking is threatened by cheaper raw materials.

213. Rothbaum, H.P.
Self-heating of esparto grass.
J.Appl. Chem. (London) 14, no. 10:436-9 (Oct., 1964).

Moist esparto grass undergoes spontaneous heating to a lesser extent than hay, but microbiological heating leads to further chemical heating at a R.H. of approximately 96%. Esparto grass has a considerably smaller moisture content than hay when in equilibrium at this R.H.

<u>Jute sticks</u>

214. Tapadar, D.C.
Utilization of jute sticks for pulp and paper.
J. Proc. Inst.Chemists (India) 35, Part 2:63-71 (March, 1963).

Topics discussed include jute plant biology and characteristics, availability, the history of jute pulping research, the physical and chemical characteristics of the total plant, fiber analysis, pulping processes, collection and storage of the raw material, and stock preparation and conversion into paper.

Kenaf

215. Adamson, W.C., White, G.A., and Minton, N.A.
Kenaf for pulp: breeding and production research progress.
Tappi C.A. Report no. 34 (Nonwood fiber pulping. A progress report): 91-106 (1970).

New developments in breeding and production of kenaf for pulp and papermaking are reviewed.

216. Atchison, J.E.
Kenaf: a potentially important fast-growing non-wood fiber for manufacture of pulp and paper.
Indian Pulp Paper 24, no. 1:1-7 (July, 1969).

After a brief outline of the general characteristics of kenaf, its utilization for pulp and papermaking is discussed in some detail. Also considered are rate of growth, planting, availability of seed, harvesting, and storage.

217. Clark, T.F., Cunningham, R.L., Lindenfelser, L.A., Wolff, I.A., and Cummins, D.G.
Search for new fiber crops. XVI. Kenaf storage.
Tappi C.A. Report no. 34 (Nonwood fiber pulping. A progress report): 107-32 (1970).

Methods of storage and preservation of kenaf which would allow year-round operation of a pulp or board mill are described.

218. Miller, D.L.
Kenaf - a potential papermaking raw material.
Tappi 48, no. 8:455-9 (Aug., 1965).

Kenaf is a potential papermaking raw material in certain regions of the United States in competition with wood, cereals, and other traditional crops. The competitive economics of growing kenaf and established crops are presented.

219. Trotter, W.K., and Corkern, R.S.
Kenaf economics: a preliminary view.
Tappi 51, no. 10:99-103A (Oct., 1968).

Estimated costs of producing and harvesting kenaf were developed for 10 farming areas representing different southern U.S. conditions. On a delivered-to-mill basis, these costs were significantly below average costs for roundwood delivered by rail to mills in the region. Kenaf with dry fiber yields of 6 tons per acre or better should also be able to compete with corn and soybeans for land use in most areas, but not with cotton.

220. White, G.A., Adamson, W.C., and Higgins, J.J.
Kenaf, an annual pulp crop for the United States.
Ippta 7, Conference No.: 1-7 (Nov., 1970).

The authors discuss the utilization of kenaf for pulp, the culture of kenaf, breeding and nematode resistance studies, and dry matter yields of kenaf.

Papyrus

221. Steenberg, B.
Papyrus: problems in its utilization for pulp and paper.
ECA/BTAO/FAO CONF/Paper II.b.16. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

A review is given of the research work carried out on the ecology of papyrus, its morphological characteristics, and methods of depithing and pulping. On the whole, papyrus cannot be considered a feasible raw material for pulp and paper.

Reed

222. Chivu, I.A.
Use of reed as raw material for pulp and paper.
Ippta Souvenir no.: 76-87 (1964).

This discussion covers reed harvesting techniques; storing, baling and conveying of reeds to the customer; effects of site development and mechanized harvesting on reed reserves; and the industrial uses of reeds, particularly their use as papermaking raw material.

223. Derbentsev, F.F., and Grishakov, A.F.
The preparation of reed for transportation, storage, and processing.
Bumazh. Prom. 34, no. 9:20-2 (Sept., 1959). (Russ.)

A description is given of a newly developed machine which sorts reed, presses and ties it into flat stacks, and cuts the stacks into desired lengths in a continuous operation.

224. Fedorovici, C.
Optimizing the transportation technology of harvested reed.
Celuloza Hirtie 11, no. 2:41-8 (Feb., 1962). (Rom.)

The methods of harvesting and processing of reed are reviewed, and the economics of reed handling and transportation from harvest to storage areas are analyzed. The most economical method is shown to involve the use of tractors, trailers, and compacted-soil storage and shipping platforms.

225. Fieger, Gh.
The baling of reed.
Celuloza Hirtie 8, no. 9:281-6 (Sept., 1959). (Rom.)

Machines and techniques used for baling and handling harvested reed are described. Some reference is made to baling experiments abroad, to special baling-press design, and to recommended improvements.

226. Foteev, S.P.
The processing of reed.
Bumazh. Prom. 35, no. 12:15-17 (Dec., 1960). (Russ.)

Two new machines, the KTS-2 reed harvester and the TST-2 reed transporter, are described. The best methods fo· harvesting and processing reed (baling, drying, chopping, and cleaning) are discussed.

227. Galkin, A.F.
Storage of reed.
Bumazh. Prom. 37, no. 11:10-11 (Nov., 1962). (Russ.)

Experience with reed storage in the delta of the Volga showed that deterioration could be largely prevented by chopping the reed when harvested, drying it partially, and storing it in warehouses. The problem of transport from the field to the warehouse can be solved by adequate mechanization of the whole process of reed harvesting and handling.

228. Grishankov, A.F.
A reed-baling apparatus.
Bumazh. Prom. 37, no. 11:9-10 (Nov., 1962). (Russ.)

A simple and lightweight device for continuous baling of harvested reed is described.

229. Lapovita, A.
Mechanized reed harvesting by the "pre-baling method."
Celuloza Hirtie 12, no. 5/6: 153-64 (May/June, 1963). (Rom.)

The "pre-baling method" used for harvesting reed is described in detail.

230. Lyskov, M.I.
Mechanization of the harvesting and transportation of reed.
Bumazh. Prom. 36, no. 3:20-3 (March, 1961). (Russ.)

New reed-harvesting and transporting machinery designed since 1959 is described.

231. Moseanu, A.
New devices for loading reed bales onto barges.
Celuloza Hirtie 10, no. 12:421-8 (Dec., 1961). (Rom.)

A detailed description of the new devices is presented.

232. Muresan, L., Talis, F., and Rolea, M.
Study of methods of sampling fibrous papermaking raw materials for moisture determinations.
Celuloza Hirtie 12, no. 7:235-44 (July, 1963). (Rom.)

The results of moisture determinations in different lots of conifer logs and wood residues, reed, and straw are analyzed statistically in order to arrive at suitable sampling methods. Recommendations on the locus of sampling and number of samples are given.

233. Perlov, S.A., and Vaikhanskii, S.S.
Setup of a plant for the preparation and purification of chopped reed.
Bumazh. Prom. 38, no. 3:17-19 (March, 1963). (Russ.)

The reed preparation and purification system adopted at the Astrakhan reed-pulping mill comprises a chopper, a dust-removing screen connected with a cyclone, and a classifier chamber containing two vibratory screens, where the material is separated into stem particles, light waste (leaves, ears, sheaths) and heavy waste (nodes and large stem particles). Extensive trials were made to determine the efficiency of the system, which was found to be adequate.

234. Petrescu, N., Zamfirescu, M., and Toba, G.
Toxicological studies on industrial dust hazards in the chipping of annual plants for pulp manufacture.
Celuloza Hirtie 15, no. 6:232-9 (June, 1966). (Rom.)

Dust particles developed in the handling and chipping of straw and reed may cause occupational hazards (silicovolcanokoniosis). An extensive study was made to investigate the concentration, mineral composition, SiO_2 content, and particle size of dusts in chipper rooms of straw and reed pulp mills. The results indicated a high amount of medium-size particles (2-9 mm) and inorganic constituents, especially SiO_2, in the chipper room atmosphere.

235. Potolov, A.P.
Reed-chopping machines.
Bumash. Prom. 38, no. 9:29 (Sept., 1963). (Russ.)

The reed-processing equipment installed at two reed pulp mills in USSR (at Kherson and at Astrakhan) is described. The operation of the reed choppers, and their advantages and drawbacks, as compared with machines of other types, are discussed.

236. Reichmann, E., Neculau, Gh., and Obreja, C.
A decade of integral industrial utilisation of Danubian reed.
Celulosa Hirtie 15, no. 4:121-38 (April, 1966). (Rom.)

A comprehensive review is given of the research and development work in the utilisation of reed (Phragmites communis), emphasising Romanian achievements in reed cultivation, harvesting, materials handling, and processing into pulp and paper. An extensive bibliography is appended. 315 references.

237. Roman, T., and Roman, L.
Storage decay of stacked reed.
Celulosa Hirtie 12, no. 11:353-6 (Nov., 1963). (Rom.)

It was found that the rate of microbiological degradation of stored reed mainly depended on the temperature and moisture content inside the stacks.

238. Rudescu, L., and Ziemiancovski, V.
Early defoliation of reed in the Danubian Delta.
Celulosa Hirtie 12, no. 7:209-13 (July, 1963). (Rom.)

The chemical defoliation of reed with spray solutions of $KClO_3$ is one of the most effective means for greatly decreasing the number of leaves and the moisture content of the stalks - two factors which normally hinder the early harvesting of reed. However, the area treated with the reagent must not be treated the following year again.

239. Tal'yanker, M.Ya., and Skalatskii, V.K.
Baling presses for reed and other materials.
Bumazh. Prom. 37, no. 4:12-14 (April, 1962). (Russ.)

A description is given of commercially available baling machines of Russian, German, and Romanian design. Three automatic presses were found to be the most suitable for baling harvested reed, although they do not correspond to the maximum requirements for this material. Suggestions are made concerning improvements in the design of baling presses.

240. Tepla, N.I.
Method of preserving reed.
Khim. Pererabótka Drevesiny, Sb. 20:3-5 (1963). (Russ.)

Wolman salt, and Boliden and Ascu preparations were tested for their efficiency in protecting stored reed against fungi. Treatment with Boliden or Ascu of a specific gravity 1.04, or with Wolman salt of a 2.5% concentration fully protected baled and stacked reed having an initial moisture content of 28% for a period of 1.5 years. Chopped and pressed reed stalks (initial moisture content 19%) were protected against biological degradation for 6 months during spring and summer.

241. Wiedermann, A.
Utilisation of reed in the pulp industry.
Tappi C.A. Report no. 40 (Non-wood fiber pulping. Progress report no. 2): 309-33 (1971).

The utilization of reed (Phragmites communis) for papermaking is limited to a few countries, though reed can be pulped successfully by several processes. That may be due to the high loss of material (up to 50% or more) incurred during preliminary handling (harvesting, transport, cutting, tying, baling, storage, and separation of leaves, knots, and tops), chipping, and drying. Specially designed harvesting and processing machines have to be used.

<u>Straw</u>

(see also abstract no. 153., 232., 234.)

242. Fouad, Y.
The collection and economics of rice straw for pulp and paper manufacture.
ECA/BTAO/FAO CONF/Paper II.b.19. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

Estimates are given of the cost of baling and transporting rice straw and of the capital investment required in these operations. A new method of cleaning rice straw is described. Other subjects covered are: characteristics of rice straw fiber; pulping of rice straw; recovery of black liquor; use of rice straw pulp for papermaking.

243. Linkovski, R.
Storage of straw - the determining factor for the production of good quality pulp at low cost.
Tseluloza Khartiya 1, no. 4:45-6 (July/Aug., 1970).

The straw supplied to the pulp and paper mill near Miziya, Bulgaria, frequently does not meet the requirements, and as a result considerable difficulties have been experienced in processing the raw material. The problem has been solved by the construction of concrete storage tanks at the mill, and quality control at the farms. In addition, instruction was given to the workers concerning proper means of harvesting, processing, and transporting straw.

244. Misra, D.K.
Modern methods of collecting, purchasing, storing, and preservation of straw.
Tappi C.A. Report no. 40 (Non-wood plant fiber pulping. Progress report no. 2): 279-307 (1971).

This illustrated discussion of straw handling and processing is based on experience gained at Thessalian Pulp & Paper Inds., Larisa, Greece. Cost data are included.

245. Moscu, V.
Shredding and sorting of straw for pulp manufacture.
Celulosa Hirtie 11, no.2: 70-2 (Febr., 1962). (Rom.)

Methods of shredding and sorting straw are described.

246. Popescu, G.
Organisation of straw storage in bulk.
Celulosa Hirtie 16, no. 3/4:90-3 (March-April, 1967). (Rom.)

Suggestions are given for the handling of moist straw shipments by pulp mills, for the construction of storage stacks, and precautions to be observed to avoid self-ignition.

247. Popescu, G., and Reichmann, E.
Conditions for self-ignition of wheat straw in storage stacks.
Celulosa Hirtie 16, no. 1:2-11 (Jan., 1967). (Rom.)

Temperature and moisture changes, as well as microfloral developments, were measured in experimental storage stacks of moist straw bales. Conditions favorable to the growth of thermophilic bacteria and fungi were observed. Local temperature elevations beyond 80°C led to actual self-ignition.

248. Sandovici, S.
Storage of straw in pulp mills.
Celulosa Hirtie 10, no. 5:156-60 (May, 1961). (Rom.)

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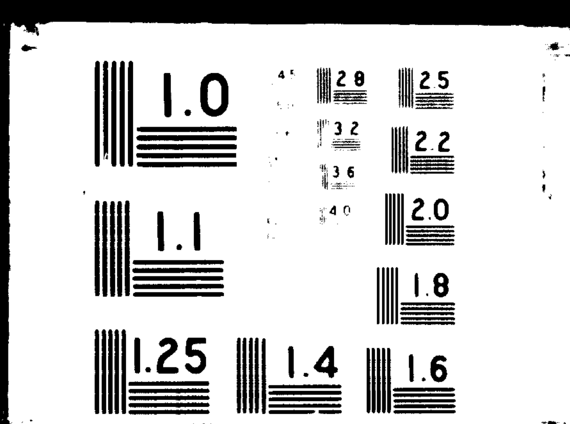

Economic and materials-handling considerations in the storage of straw bales in high-capacity mills are discussed, and suggestions for the constructions of improved storage magazines are presented.

249. Slamet, A.
Harvesting, collection and storage of rice-straw.
ECA/BTAO/FAO CONF/Paper II.b.20. Proceedings of the Conference on Pulp and Paper Development in Africa and the Near East. Cairo, 1965.

This report deals with the harvesting, collection and storage of rice straw as practised in Indonesia. The small amount of straw so far used for pulp manufacture is carried to collecting points where it is baled by mobile baling machines.

250. Wettstein, R.
Straw pulp - a special pulp.
Wochbl. Papierfabr. 90, no. 9:433-40 (May, 1962). (Ger.)

Problems of straw harvesting and handling (transportation, cleaning, etc.), morphological, chemical, and papermaking characteristics of straw fibers, and the manufacture and applications of straw pulp are reviewed.

Sorghum

251. Bajai, J., Hajduczky, G., Lengyel, P., and Molnar, L.
Investigation of the possible papermaking application of Sudanese sugar sorghum.
Papiripar 6, no. 5:204-10 (1962). (Hung.)

Since Sudanese sugar sorghum (Sorghum sudanese) resembles wheat straw in stalk height and diameter and amount of leaves, it can be baled, chopped, and cleaned by a dry method in the same equipment and by the same technology that are used for straw. Large scale pulping trials yielded pulp with strength properties equivalent to those of wheat straw pulp.

D. PROCESSES FOR VARIOUS TYPES OF PANELS.

General

252. **Akers, L.E.**
Particle board and hardboard.
New York, Pergamon Press, 1966. 172 p.

This monograph deals with the types, manufacture, physical properties, evaluation, handling, machining, and utilization of particle boards and hardboards. A glossary of terms and an index are appended.

253. **Chittenden, A.E.**
Historical outline of past research on the production of boards from agricultural wastes and future trends.
ID/WG.83/2 & Corr.1. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14 - 18 December 1970. 8 p.

The possibilities for using agricultural wastes as a raw material for the manufacture of fiberboards, particle boards, and similar products are discussed by the author while reviewing the past research on this subject. A check-list of agricultural waste materials tested for board-making, a table of the number and production capacity of plants utilizing agricultural wastes for fiberboard and particle board, and a bibliography including 128 references are appended.

254. **Deppe, H.J., and Ernst, K.**
Particleboard technology. (Technologie der Spanplatten).
Stuttgart, Holz-Zentralblatt Verlags-GmbH, 1964. 283 p. (Ger.)

This well illustrated book provides fundamental and practical information on the manufacture of particle board. Its 5 chapters cover the following subjects: history; raw materials; manufacturing processes; quality control; and properties of particle board.

255. **Eisner, K., and Travnik, A.**
Some experiences in research and manufacture of panels from agricultural wastes and non-wood fibrous raw materials in Czechoslovakia.
ID/WG.83/CR.2 UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 19 p.

The suitability of various agricultural residues and other non-wood fibrous raw materials for panel production is discussed, the research carried out on this subject in Czechoslovakia being emphasized. Fibrous materials considered are: corn cobs, flax and hemp shives, bagasse, cotton stalks, palm-tree waste, bamboo, papyrus and reeds, esparto grass. The physical and strength properties of boards made from bagasse, cotton stalks, palm waste, bamboo, and esparto grass are tabulated.

256. Food and Agriculture Organization. (U.N.)
Fibreboard and Particle Board.
Report of an International Consultation on Insulation Board, Hardboard and Particle Board, Geneva, 21 Jan. to 4 Feb., 1957.
FAO, Rome, 1958. 178 p. + 12 p.

This report discusses the following subjects: product description, nomenclature and definitions; world production, consumption and trade; raw materials (incl. non-wood fibrous raw materials); processes and equipment; economic aspects of production and marketing; properties, applications and uses; research needs. A survey of testing methods and a list of mills and trade associations are appended.

257. Food and Agriculture Organization. (U.N.)
Plywood and other wood-based panels.
Report of an International Consultation on Plywood and Other Wood-Based Panel Products, Rome, 8-19 July, 1963.
Rome, FAO, 1966. 223 p.

The 7 chapters of these proceedings deal with the following subjects: I. Product description, nomenclature, standards, and specifications. II. Raw materials. III. Manufacturing processes and equipment. IV. Economic aspects of production. V. Properties and uses of wood-based panel products. VI. Production, trade, consumption, and demand trends. VII. Research and development needs. Chapter III. is divided into two parts, one covering the manufacture of veneer, plywood, and blockboard, the other covering the manufacture of fiberboard, particle board, and wood-wool board.

258. Food and Agriculture Organization. (U.N.)
FAO Committee on Wood-Based Panel Products.
(a) First Session, Rome, 12-14 Dec., 1966 (FAO/WBPP/66).
(b) Second Session, Rome, 6-8 Nov., 1968 (FO:WPP/68).
(c) Third Session, Rome, 2-4 Dec., 1970 (FO:WPP/70).

The documents and country statements submitted to the three sessions of the FAO Committee on Wood-Based Panel Products, and the final reports adopted by the Committee provide useful informations on the present situation and future trends in the market for wood-based panels. their manufacture and application, and on marketing problems.

259. Hesch, R.
Annual plants as raw material for the particle board industry.
Holz Roh- u. Werkstoff 26, no. 4: 129-40 (April, 1968). (Ger.)

A general review is given of present and future important raw materials for particle board other than wood, particularly flax, hemp, jute, and bagasse. Both the economics and technology of their use are discussed in some detail.

260. Klar, G.V., and Vankov, P.I.
"Arbolite" with a modified structure.
Lesnaya Prom. 47, no. 8: 27-8 (Aug., 1967). (Russ.)

Arbolite constructional boards are made of portland cement with a cellulosic filler, such as wood particles or milled agricultural residues. Their drawback is a mechanical strength too low for use under high load without additional reinforcement. Experiments were carried out to determine whether orientation of the filler particles would increase the mechanical strength of Arbolite. The boards were made from ordinary wood particles (13 by 3.2 by 2.4 mm) or specially prepared wood shavings at wood particle:cement ratios of 1:1.5, 1:2, and 1:3. It was found that orientation increased the bending strength in the direction parallel to particle orientation by more than 50%, but reduced it in the transverse direction. Water absorption was not affected by orientation.

261. Kollmann, F.
Wood-particle board. (Holzspanwerkstoffe).
Berlin, Heidelberg, New York, Springer-Verlag, 1966. 821 p. (Ger.)

This book presents a most comprehensive, illustrated survey of its subject contributed by a staff of 21 authorities. Its 9 chapters cover the following topics: history, consumption and production of particle board; raw materials; fundamentals of particle board technology; particular manufacturing processes; production of molded products; physical and mechanical properties, testing methods; statistical quality control; economics of particle board manufacture; machining and finishing of particle board. Appendices include a world list of particle board plants, a list of suppliers of equipment for the particle board industry, and German standards related to particle board.

262. Lampert, H.
Fiberboard; raw materials, methods of production, properties. (Faserplatten; Rohstoffe, Herstellungsverfahren, Eigenschaften).
Leipzig, VEB Fachbuchverlag. 1967. 453 p. (Ger.)

The contents of this book, as reflected in the main chapter headings, include the following topics: history of fiberboard manufacture; raw materials (morphological and chemical characteristics, harvesting and storage); methods of fiberboard manufacture (wet processes, semidry and dry processes); physical and mechanical properties of fiberboard.

263. Lepeut, M.
The dry process for the production of fibreboards.
ID/WG.83/6. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 12 p. (Fr.)

The advantages of the dry process for the production of fiberboard as compared to the wet process are outlined. Although experience is limited with raw materials other than wood, there should be no difficulties with agricultural wastes.

264. Mestdagh, M.
Particle board from annual plant wastes.
ID/WG.83/5. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 45 p.

A review is given of the manufacture of particle board from agricultural residues, especially from flax shives and bagasse. The physical properties of phenolic resin-bonded flaxboards and bagasse boards are reported. Other fibrous materials considered are: hemp, jute and other bast fibre plants, cotton stalks, rice hulls, groundnut shells, cereal straw, corn stalks, sisal abaca and coconut fiber, bamboo, reed, palm leaves, and palm trunks. The technical feasibility of using tannin extracts as a binder for particle board is discussed. The potential value of particle boards in the construction of prefabricated houses in developing countries is pointed out.

265. Mitlin, L.
Particleboard manufacture and application.
Pressmedia Ltd., 1968, 222 p.

This book presents a collection of chapters by various specialists in particle board manufacture - Mr. Mitlin being the editor and a principal contributor. Topics include raw materials and their effect on technology, additives and after-treatments, machinery, processes, economic aspects, conversion and applications and surface treatment by resin impregnated paper, veneering, painting and lacquering. Four appendices give standards, conversion tables and other useful data.

266. Narayanamurti, D.
Fibre boards.
Indian Pulp Paper 16, no. 1: 29-50 (July 1961).

A review is given of the research work conducated by the author on the production of fiberboards from raw materials indigenous to India. The manufacturing processes used are described, and a great deal of tabular statistics on the properties of fibrous materials and finished boards is presented.

267. Sandermann, W.
Technical processes for the production of wood-wool/cement boards and their adaption for the utilization of agricultural wastes.
ID/WG.83/4 and corr.1, UNIDO Expert Working Group Meeting on the Producation of Panels from Agricultural Residues, Vienna, 14-18, Dec.1970, 32 p.

Following the description of technical processes used in the manufacture of cement-bonded boards and building blocks, the availability of agricultural residues and their suitability for the production of cement-bonded products are discussed. Certain fibrous materials contain cement-setting inhibitors making the production of satisfactory boards difficult. Tests have demonstrated, however, that many agricultural wastes yield cement-bonded products having almost the same properties as those from wood-wool shavings. The equipment needed to manufacture cement-bonded boards from agricultural residues and wood-wool is similar. The present situation and future trends in this market are outlined.

268. Schmitz-Le Hanne, A., and Lynam, F.C.
Questions that must be answered before investing capital in a wood-based panel operation.
FO: WPP/70/4.1. FAO Committee on Wood-Based Panel Products, Third Session, Rome, 2-4 Dec., 1970. 21 p.

This paper includes two preliminary questionnaires that should be completed before going on to the next stage of projecting a new particle board plant, i.e., a full feasibility study.

269. United Nations Industrial Development Organization.
Production of panels from agricultural residues.
Report of the Expert Working Group Meeting, Vienna, 14-18 Dec., 1970.
New York, United Nations, 1972. 37 p.

The final report of the Expert Working Group Meeting outlines the economic and technical aspects of producing panels from agricultural wastes, and formulates the measures the developing countries must take to make fuller use of their potential raw materials. The documents submitted to the meeting have been abstracted separately and can be found in this bibliography by the name of their author.

270. Verbestel, J.B.
Some experiences with and possibilities for the manufacture of particle boards from non-wood fibrous raw materials.
WPP/68/4.5. FAO Committee on Wood-Based Panel Products, Second Session, Rome, 6-8 Nov., 1968. 23 p. (Fr.)

Large-scale commercial production of particle board from non-wood fibrous raw materials is limited to bagasse, flax and hemp residues, jute sticks, and cotton stalks. The board-making processes used are briefly described, and the properties of the boards obtained are tabulated. Other agricultural wastes that have been tested, but are not used industrially, include bamboo, abaca, ramie, sisal, kenaf, coconut-tree, palm leaves and palm fruit stems, and groundnut shells. Density and strength properties of boards made experimentally from these materials are reported. Figures of cross sections of bagasse, jute sticks, cotton stalks, and other agricultural residues are appended.

271. Weiner, J., and Byrne, J.
Hardboards. I. Fiberboards. II. Particle boards. III. Inorganic and miscellaneous boards.
Appleton, Wis., Institute of Paper Chemistry, Bibl.Ser. no. 209-211, 1964. 228 + 120 + 137 p.

This 3-part bibliography on hardboard covers the pertinent literature up to ca. mid-1962. Part I concerned with fiber boards (hot--pressed building, insulating, paneling, decorative, and other kinds of board) made from pulp or fiberized wood. Part II deals with structural and other boards made from wood chips, shavings, flakes, etc. Part III covers inorganic and miscellaneous boards, such as gypsum board, plaster board, asbestos board, hardboard-plywood laminates, and related products which do not fall into the other two classifications.

272. Weiner, J., and Pollock, V.
Hardboards (Supplement I). I. Fiberboards. II. Particle boards. III. Inorganic and miscellaneous boards.
Appleton, Wis., Institute of Paper Chemistry, Bibl. Ser. no. 209-211, Supplement I, 1971. 150 + 250 + 85 p.

This bibliography is Supplement I to the IPC Bibliographic Series No. 209-211 (see preceding abstract).

Abaca

(see abstract no. 270)

Areca-nut husks and areca palm stem

273. Narayanamurti, D., Gupta, R.C., and Ratra, Y.S.
Utilization of areca palm stems.
Res.Ind. 7: 340-3 (1962).

The production of particle board, fiberboard, and plastic board from areca palm stems has been studied.

274. Narayanamurti, D., Ranganathan, V., and George, J.
Studies on building boards. I. Utilization of areca-nut husk waste.
Indian Forest Leaflet no. 112 (1947). 9 p.

Data are given on the chemical composition of areca-nut husks. The husks are a suitable source of furfural that is obtained in 19 % yield (based on dry material) on distillation with acids. Satisfactory building boards can be made by pulping the husks by the Asplund process or a hydrolytic treatment with dilute acid or alkali, and then pressing the pulp to boards in the usual way.

275. Narayanamurti, D., and Singh, H.
Studies on building boards. VII. Building boards from tannin-containing lignocellulosic materials.
Composite Wood 1, no. 5: 121-4 (Sept., 1954).

Building boards were prepared experimentally from indigenous tannin-containing waste, in particular from areca-nut husk, spent tea leaves, and sal bark. Furfural or formaldehyde was added to the powdered material. Tea leaves gave the poorest results; with areca-nut husk, good strength was obtained only when high pressures were applied; sal bark alone gave board of good strength, which was further improved by the addition of sawdust.

276. Narayanamurti, D., and Singh, H.
Studies on building boards. VIII. Production of building boards from various woods and barks by defibration.
Composite Wood 2, no. 1:6-15 (Jan., 1955).

Asplund pulps were prepared from indigenous Indian raw materials, including areca-nut husk, bamboo shavings, tannin-extracted sal bark, and different wood species, and then wet pressed into insulating and hardboards. The effect of operating conditions on board properties was studied in some detail. The outer portion of bamboo, containing waxes and resinous materials, gave products with higher moisture resistance and better strengths than the inner portion. Moisture absorption and swelling of boards made from areca-nut husk could be reduced by treating the pulp with alkali prior to forming into boards. Data on the chemical composition of the pulps and the physical properties of the resulting boards are given in tabulated form.

Bagasse

(see also abstract no. 255; 259; 264; 270)

277. Bagasse Products Ltd.
New particle board from crushed sugar cane fiber.
Board Mfr. 9, no. 10:172-3 (Oct., 1966).

278. Borlando, L.A.
Panels of sugar cane bagasse and synthetic resin.
Plast.Resinas 6, no. 29: 4-7, 10-12 (1964). (Span.)

Particle boards were manufactured from sugar cane bagasse agglomerated with UF resin. Experimental results of the study are reported.

279. Cherkasov, M., and Lodos, J.
Use of furfural-urea resin for production of particle board from bagasse.
Sobre Deriv. Cana Azucar 3, no. 2: 13-17 (1969). (Span.)

Urea-furfural resins were prepared, combined with bagasse, and cured in the presence of various acid catalysts to yield particle board with excellent rupture modulus, and low water absorption and thickness swelling. The physical properties of the boards were superior to those obtained by using a urea-formaldehyde resin binder.

280. Christensen, F.J., and Christensen, M.L.
The production of hardboard from bagasse and a cresol resin.
C.S.I.R.O., Division of Forest Products. 1955. 18 p.

The possibility of producing a high grade hardboard by the dry process from bagasse bonded with a cresol formaldehyde resin was investigated. An examination was made of the effects of resin content, moisture content, pressing time, and temperature on the properties of material pressed at 500 lb/sq.in. The resin content was varied from 2 to 10 %, moisture content from 0 to 17 %, and pressing temperature from 188 to 210°C. The resin content greatly influenced water resistance and modulus of rupture. Attempts to produce a satisfactory board with a resin content of 2 % were unsuccessful.

281. Colonial Sugar Refining Co. - Building Materials Division.
Bagasse as a raw material for insulation board.
FAO/ECE/BOARD CONS/Paper 4.13. Fiberboard and Particle Board. Report of an International Consultation on Insulation Board, Hardboard, and Particle Board, Geneva, 1957.

The utilization of bagasse as a raw material for insulation boards is discussed. In general, bagasse is used in conjunction with a substantial amount of repulped waste paper(up to 30 %)and/or other fiber to improve stiffness, wet strength, and appearance of the boards. The procedure for pulp preparation described in this paper includes cooking of bagasse with water in rotary digesters at a pressure of 3.2 kg/cm^2 for 15 min with the addition of small amounts of lime, and defibration in a double disc refiner readily after the softening treatment. The pulp is mixed with waste paper and eucalyptus pulp, formed into a mat using an Oliver vacuum drum-type machine, and dried in an 8-deck drier. In addition to common insulation boards, medium density hardboards and coated boards can be made successfully.

282. Guha, S.R.D., Singh, M.M., Mukherjea, V.N., and Saxena, V.B.
Fiberboards from bagasse.
Indian Pulp Paper 20, no. 4: 255-6 (Oct., 1965).

Laboratory experiments on the production of insulation boards and hardboards from bagasse are described. Bagasse soaked in water for 15 hr was steamed at a pressure of 8 kg/sq.cm.for 5 min (to yield insulation board) or 15 min (for hardboard), then defibrated, formed into sheets, and dried at 190°C for 30 min at zero pressure (insulation boards) or at 32 kg/sq.cm. (hardboards). The average yield of board, based on bagasse, was 83 %. The boards had satisfactory properties.

283. Hansen, R.M.
Utilization and mechanical separation of sugarcane bagasse.
Dissertation, Louisiana State University, Publ. no. 12,522 (1955). 207 p.

284. Hesch, R.
Particle board from bagasse. I. Bagasse as a raw material for particle board. II. Manufacture of bagasse particle board on the Island of Reunion.
Holz-Zentralbl. 93, 83: 1335 (1967); 93, [illegible]: 1367 (1967). (Ger.)

Following a review of the morphological and chemical characteristics of bagasse, the manufacture of bagasse particle board as practised at the new board plant on the island of Reunion is described in some detail. The properties of the bagasse boards are compared with those of boards made from other annual plants and wood, showing that bagasse is a most suitable raw material for particle board. Some applications of bagasse particle board are outlined.

285. Hesch, R.
Particle board from sugar cane: a fully integrated production plant.
Board Mfr. 10, no 4: 39-45 (April, 1967).

The process and equipment used at the Bagapan plant on the Island of Reunion for the manufacture of particle board from bagasse are described. At present, the plant operates only during the sugar cane season (July-Dec.), but plans are being made to store sufficient bagasse for year-round operation. Bagasse is depithed in special machines in two stages (the pith content being 20-35%), then dried, mixed with the binder, and hot-pressed in the same way as boards made from wood particles. The boards produced range in thickness from 8 to 35 mm, and in density from 300 to 750 kg/cu.m. Strength properties are comparable to those of similar boards made from jute sticks, hemp and flax shives, and various species of wood. The bagasse particle boards can be used for flooring, wall partitioning , ceiling and roofing, furniture, etc.

286. Hesch, R.
Fiberboard from bagasse for the construction and furniture industry: A new bagasse plant at Reunion.
Z. Zuckerind. 18, no. 3: 114-20 (1968). (Ger.)

The content of this article is similar to that of the preceding abstract.

287. Hesch, R.
Annual plants as a raw material for the particle board industry.
Holz Roh- u. Werkstoff 26, no. 4: 129-40 (April, 1968). (Ger.)

In the first part of this article, the availability of annual plants and their potential as a raw material for particle board are discussed. The second part deals with the manufacture of particle board from jute, flax, hemp, and bagasse, including transportation, handling, cleaning, and pretreatment of the fibrous materials. Bagasse is an especially suitable raw material for particle board since particle size and particle form can be adapted to specific requirements as can be done with wood but not with jute, flax, and hemp. In the lower density range, e.g., 300 kg/m^3, bagasse particle board show strength properties superior to those of wood particle boards.

288. Hesch, R., and Frers, H.
World's biggest bagasse board industry in Pakistan.
Board Mfr. 11, no. 12: 149-58 (Dec., 1968).

289. Huang, H.-C.
Quality improvement of bagasse particle board with low resin content.
Taiwan Sugar 13, No. 5: 23-5, 29 (1966).

A study was made of the effect of resin (UF) content and resin extender on the quality of bagasse particle board. The results can be summarized as follows: Resin spraying conditions have no effect on board quality. Reducing the resin content to less than 6 % results in an abrupt decrease in board strength. Neither wheat flour nor sodium silicate are suitable resin extenders. Sulfur is an extender, but the long hot-pressing time required makes it uneconomical to use. Good results are obtained when using asphalt as an additive. Board containing 6 % resin, 2 % asphalt, and 1 % paraffin wax has a water absorption of 8.6 % and a thickness swelling of 11.8 % after 24-hr-immersion in water. Strength properties of the board are satisfactory..

290. International Cooperation Administration.
Plant requirements for manufacture of wallboard from bagasse.
International Cooperation Administration, Technical Aids Branch, Washington, D.C. (May, 1959). 30 p.

291. Jain, N.C., Gupta, R.C., Bajaj, S.C., and Singh, D.D.
Note on the utilization of sugar cane leaves.
Indian Pulp Paper 19, no. 5: 365-6 (Nov., 1964).

Preliminary trials on the use of sugar cane leaves as a filler and an extender in plywood manufacture and for manufacturing hardboard are reported. When used as a filler or extender glue adhesion values were satisfactory up to [illegible] % extension. Hardboards made from sugar cane leaves had suitable characteristics although board strengths were low. Cooking sugar cane leaves in 3 % NaOH produces a material of sufficient strength to be utilized as a low grade hardboard. Trials for use in chipboards were not encouraging. Up to 30 % powdered leaves may be used as a filler and extender in phenol-formaldehyde resins.

292. Kehr, E., and Schölzel, S.
Bagasse and other residues of annual plants as a raw material for particle board.
Holztechnol. 3, no. 3:225-32 (Dec., 1962). (Ger.)

The suitability of bagasse and some other ligno-cellulosic residues, such as flax shives, rape straw, reed, sunflower seed husks, and groundnut shells as a raw material for particle board has been studied. The physical properties of the boards prepared from various residues on a lab scale are tabulated. While the utilization of annuals other than bagasse is only touched on, the manufacture of particle board from bagasse is described in some detail. Single-layer as well as three-layer boards were prepared using 5-12% urea-formaldehyde resin as a binder. Satisfactory products were obtained by pressing the material at 170° C and 15 kg/sq. cm for 6-10 min.

293. Kolejak, M., and Rajkovic, E.
Particle board from bagasse and bamboo.
Drevarsky Vyskum no. 2: 103-16 (1961). (Slovak.)

Various types of experimental particle boards (single- and three-layer construction boards, boards overlated with resin-impregnated paper, thick insultation boards, and 5 mm thin boards) were manufactured from depithed bagasse and bamboo chips. The two materials were found to be perfectly suitable for all types of board. The mechanical properties and water absorption of the boards obtained are tabulated.

294. Lengel, D.E.
Investigations to determine optimum methods of producing bagasse-fibre boards in the softboard, particle board, and hardboard density ranges.
Proc. Intern. Soc. Sugar-Cane Technologists 11: 1156-74 (1962).

The results of the investigations conducted by the author provide evidence that insultation and structural boards can be manufactured economically from bagasse. The bagasse-fiber boards have satisfactory physical and mechanical properties and can compete well with wood-fiber boards in the insulation board, hardboard, and particle board market.

295. de Lumen, B.O., Villanueva, L.J., and Bawagan, P.
Properties of hardboard from sugar cane bagasse.
Philippine Agriculturist 46, no.9: 717-28 (1962).

Undepithed and depithed bagasse was pulped by the cold soda process, passed through an 8-inch attrition mill, and formed into circular pulp mats approximately 8.5 inch in diameter. The mats, without sizing, were pressed to hardboard by using an initial max. pressure of 710 lb/sq.in. for 1 min at 171°C. The hardboards from depithed bagasse were superior in load capacity, stiffness, and water resistance, and showed higher values of rupture modulus and elasticity. Water absorption was lower after 15 min pressing time than after a 10- or 12-min treatment.

296. Mahanta, D., Chaliha, B.P., Lodh, S.B., and Iyengar, M.S.
Binderless process for obtaining waterproof boards from bagasse.
Ippta 7, Conference No.: 58-62 (Nov., 1970).

Experimental boards were prepared from bagasse that had been powdered to a specific size and blended with a suitable dehydrating agent. Board properties were determined as a function of particle size, temperature of the hot-press, applied pressure, and time of pressing. The results are shown in a series of graphs.

297. Miller, A.C., and Fishman, N.
Bagasse concrete.
U.S. pat. 2,837,435 (June 3, 1958).

A mixture of bagasse fiber, portland cement, lime, calcium chloride, and a pozzolan forms a lightweight concrete of use in many structural applications and in the formation of paper-faced wallboard.

298. Naffziger, T.R., Hofreiter, B.T., and Rist, C.E.
Upgrading insulating board and molded pulp products by minor additions of dialdehyde starch.
Tappi 45, no. 9: 745-50 (Sept., 1962).

Experimental insulating boards and handsheets were prepared from a range of furnishes containing sugarcane bagasse pulp and waste paper to which 2.5% cationic starch or 2.5% of both cationic starch and dialdehyde starch (DAS) had been added. Retention of as little as 0.5% DAS resulted in greatly improved dry- and wet-strength properties. With boards made from 75% bagasse-25% newsprint blends, increases of 64 and 130% in dry modulus of rupture and dry tensile strength were obtained by the use of DAS. Wet-strength increases for the same pulp blend were 400 and 900% of that of untreated boards. DAS also provides improved pulp drainage and lower board densities.

299. National Bagasse Products Corp.
Bagasse panelboard.
Ind. Woodworking 15, no. 2: 12-13 (Feb., 1963).

The manufacture and uses of bagasse fiberboard, as manufactured by the National Bagasse Products Corp., are discussed. Such boards (tradenamed Fibron) are said to offer good finishing and painting surfaces, and high density properties for machining and fastening for heavy industrial applications.

300. Nee, C.I., and Hsieh, W.C.
Feasibility study on furfural and structural board from bagasse.
Proc.Int.Soc. Sugar-Cane Technol. 13: 1881-90 (1968).

A furfural plant with a daily capacity of 7.5 tons of pure product in conjunction with a fiberboard plant which cooks 20-70 tons of bagasse daily is described.

301. Ni, Ch., Yang, Ch.-F., and Shen, T.-K.
Asphalt-impregnated bagasse board.
Taiwan Sugar Expt. Sta., Report no. 23: 125-45 (1961).

Asphalt-impregnated bagasse board was developed as an inexpensive structural material with water-proof and termite-resistant properties, and moderate strength. The best board for impregnating purposes was that from pulp of uncooked bagasse. A base board of density 0.5 g/cm^3 was suitable. Roofing asphalt or waterproofing asphalt was used as impregnating agent. Introduction of melted asphalt into the board by gravity was preferable to introduction by vacuum. The density of the resulting board was always between 0.9 and 1.0 g/cm^3, provided enough impregnation time was allowed. The impregnated board had a modulus of rupture of 200-250 kg/cm^2, water absorptivity below 10%, and showed under 5% swelling.

302. Nolan, W.J.
Processing of bagasse for paper and structural board.
Tappi 50, no. 9: 127-36A (Sept., 1967).

Thorough depithing of bagasse seems essential to high-quality pulp production. A depithing procedure developed at the author's laboratory is described (see abstract no. 183). To study the effect of depithing on yield and strength properties of kraft pulps, depithed and undepithed bagasse were cooked under different conditions. The results obtained are discussed in some detail. Depithed bagasse fiber can also be converted into wallboard of high strength and water resistance (modulus of rupture: 700 psi at a density of 16 lb/cu.ft; 1400 psi at a density of 25 lb/cu.ft; water absorption after 24-hr submersion: 25% or less). Hardboard made by wet felting and hot pressing at 400-425°F has a modulus of rupture of 8000 psi and a water absorption of 8-10% at a density of 70 lb/cu.ft. The methods used for preparing the boards are described.

303. Paul, B.B.
Prospects and economics of utilization of bagasse as raw material for pulp and paper industries in India.
Ippta 7, Conference No.: 43-8 (Nov., 1970).

The economics of bagasse purchase, collection, storage, preservation, and depithing, and the cost of bagasse particle board manufacture are discussed. The evaluation of bagasse fuel value (as compared with oil) is also touched upon. Strength properties of bagasse particle boards are compared with those of corresponding boards made from wood, flax, jute, and hemp.

304. Rengel, F., and Bartolucci, L.A.
Boards from sugarcane bagasse and quebracho tannin-formaldehyde resins.
Ind. Quim. 26, no. 3: 178-82 (1968). (Span.)

Sugar cane bagasse, comminuted to small particles, is used for board manufacture, sugar being removed to improve the mechanical resistance of the finished product. For fiber bonding, the material is mixed with a resin obtained from 50% sulfited quebracho tannin solution, formaldehyde, and hexamethylenetetramine (I). The best gelling time is 270 sec at 100°C and 9% I-concentration (based on tannin extract). After sheet formation, the material is pressed at 140-150°C, yielding boards with satisfactory strength and water resistance.

305. Shen, Tu-K.
Manufacture of hardboard from sugar cane bagasse.
Taiwan Sugar 2, no. 9: 25-30 (Sept., 1955).

A review is given of processes for the manufacture of hardboard, including fiber stock preparation, sizing, sheet formation, drying and pressing, and after-treatment. No reference is made to the utilization of bagasse with the exception of two passages dealing with fiber stock preparation.

306. Shen, Tu-K., Chang, H.W., Tseng, H.C., Yang, C.T., Ou, C.T., and Liang, C.T.
The effect of pith removal on the quality of the resulting bagasse hardboard.
Rept. Taiwan Sugar Expt. Sta. 209-22 (1955).

In the manufacture of bagasse hardboard by the conventional wet process, removal of pith results in 28% increase in flexural strength and 37% increase in wet strength. It also improves the water resistance of hardboard made from crude pulp. At a freeness level of 60 Defibrator sec., however, the effect of pith removal on water resistance is negligible.

307. Tantengco, P.T., Jr.
The preparation and physical properties of plaster board from sugar cane bagasse.
Philippine Agriculturist 42, no. 3: 201-9 (1958).

Successive one-day treatment with 1% sulfuric acid and 18% NaOH at room temperature was used to prepare bagasse for molding. Higher concentrations and longer processing periods did not increase fiber recovery or improve the quality of the resulting board. Bagasse treated with 60% urea-formaldehyde resin for 30 min at 150°C and 350 kg/sq.cm. gave the highest tensile strength and shearing stress. Unground bagasse gave products with higher strength than ground bagasse, but the latter showed much finer texture and higher surface gloss.

308. Tao, H.C.
Bagasse fibre board.
Taiwan Sugar 13, no 2: 21-25 (March/April, 1966).

The manufacture of insulating board and S-2-S hardboard from bagasse at the Changwa Board Factory, Taiwan, is described. To soften the depithed bagasse before refining, it is cooked with water, usually at a pressure of 90 psi. If other grades of board are to be produced, cooking conditions are varied. In general, about 1% rosin size is added to the pulp. After sheet formation, the wet mats are dried in a multiple-deck drier. For the manufacture of hardboard, the soft dry sheets are hot-pressed without the use of wires at 238°C and a pressure of 1400 lb/sq.in. The resulting boards have satisfactory physical properties meeting standard requirements. The difficulties involved in the utilization of bagasse are briefly discussed.

309. Tropical Products Institute.
Examination of a sample of bagasse from the West Indies for particle board production.
TPI Report no. 14/63 (1963). 7 p.

Sample preparation, and manufacture and testing of bagasse particle boards are described, and the disadvantages of bagasse as a raw material for particle board are discussed. Both single- and 3-layer boards were produced. Although the boards had satisfactory densities they did not meet the specifications of British Standard 2604.

310. Ulbricht, H.J.
The possibility of using bagasse and straw as raw material for particle board manufacture.
FAO/ECE/BOARD CONS/Paper 4.17. Fiberboard and Particle Board. Report of an International Consultation on Insulation Board, Hardboard and Particle Board, Geneva, 1957.

Experiments indicated promising possibilities for the manufacture of particle board from bagasse. UF resin (8%) was added as a binder. The strength properties of the bagasse particle boards were comparable to those of similar boards made from pine shavings, or flax shives.

311. Wu, H.S.
TSC - successfully made hard fibre board from sugar cane bagasse.
Taiwan Sugar 5, no. 6: 13-14 (June, 1958).

The Taiwan Sugar Corp. (TSC) succeeded in preparing hardboard from bagasse by adapting the manufacturing process to the particular requirements of this annual plant fiber. No details of the manufacturing process are given.

312. Wu, H.S.
The manufacture of hardboard from bagasse.
Proc. Intern. Soc. Sugar-Cane Technologists 11: 1205-11 (1962).

The process used for the manufacture of hardboard at a plant in Taiwan is described. After depithing, the bagasse is subjected to steam digestion at a pressure of 6.3 kg/sq.cm., then washed, refined, sized with rosin, formed into sheets, dried, and pressed at 100 kg/sq.cm. Dielectrical heating of prepressed mats was found to be most economical at 360 kW/1000 lb water removed.

313. Young, M.A.
Use of furfuryl alcohol in a binding resin for the manufacture of particle boards. I.
Sobre Deriv. Cana Azucar 2, no. 1: 48-54 (1968). (Span.)

Particle board with excellent water resistance and modulus of rupture was prepared by impregnating bagasse fibers with 12-14% furfuryl alcohol (I) and 7.5-10% maleic acid or toluenesulfonic acid catalyst (based on I), forming the material into a mat, and pressing it at 160-180°C to polymerize I.

Bamboo

(see also abstract no. 255; 264; 270; 27[illegible]; [illegible])

314. Bose, T.N.
Use of bamboo as reinforcement in [illegible] and cement concrete.
Ass.Eng. Calcutta J. 26, no. 2: 59-62 (1956).

315. Dhamaney, C.P.
Development of bamboo boards based on cashew-nut shell liquid.
Indian Pulp Paper 22, no. 4: 259-61 (Oct., 1967).

Various types of satisfactory bamboo building boards were produced by substituting imported phenol with cashew-nut shell liquid that yields a water-resistant adhesive when condensed with formalin in the presence of xylene and small amounts of aqueous NaOH. The physical properties of the boards obtained are tabulated.

316. Jain, N.C., and Dhamaney, C.P.
Studies on hardboard preparation. (1) From raw materials received from Nagaland.
Indian Pulp Paper 21, no. 4: 259-62 (Oct., 1966).

Experimental hardboards were prepared from twelve fibrous raw materials, including bamboos, grasses, and hardwoods, indigenous to the indicated Burma-Assam region. The materials were cooked with aqueous NaOH at atmospheric pressure for 3 hr, washed, felted, and pressed at 160°C and 56 kg/sq.cm. for 20 min. Sizing agents, such as wax emulsions, for improving water resistance were not incorporated. The boards were tempered by heat treatment or with cashew nut oil at 170°C for 3 hr. The physical properties of the boards complied with the Indian standard specifications for hardboards with regard to specific gravity and modulus of rupture, but water absorption values were too high.

317. Naffziger, T.R., Clark, T.F., and Wolff, I.A.
Structural board from domestic timber bamboo - Phyllostachys bambusoides.
Tappi 44, no. 2: 108-12 (Feb., 1961).

Dry mature timber bamboo was investigated as a raw material for the preparation of insulation boards and hardboards by several pulping techniques. Results of preliminary studies indicated that pulping with lime alone was adequate. To establish preferred manufacturing conditions, a series of experiments was conducted on a pilot-plant scale using 6, 9, and 12 % lime at 142°C for pulping. Yields of pulp when cooked for 1, 3.5, and 6 hours ranged from 83 to 94%. The resulting boards (both insulating and hardboards) had strength properties equal or even superior to those of standard commercial boards.

318. Narayanamurti, D.
Building boards from bamboo.
Composite Wood 3, no. 1: 1-13 (Jan., 1956).

A comprehensive review is given of the manufacture, properties, and uses of building boards from bamboo. The experiences so far gained with these products in the building industry are quite satisfactory. Extensive manufacturing and performance data are included.

319. Narayanamurti, D., and Bist, B.S.
Building boards from bamboos.
Indian Forest Records. Composite Wood 1, no. 2: 9-54 (1963).

A review is given of recent literature concerning the manufacture of building boards from bamboos. Some hitherto unpublished data are added.

320. Narayanamurti, D., and Singh, H.
Studies on building boards. IX. Utilization of wood waste, tree barks and other lignocellulosic materials as a source of plastics and building boards.
Composite Wood 2, no. 3: 53-62 (May, 1955).

Continuing previous investigations (see Abstract no. 276), agricultural and forest wastes, bamboo sawdust, and other lignocellulosic materials were subjected to a mild acid or alkaline hydrolysis at 160 and 170°C. Molded products and boards were formed from the hydrolyzed powders. The results are presented in tables and graphs.

321. Sano, Y., Ishihara, S., and Nagasawa, S.
Studies on the production of fiberboards from bamboo.
I. Manufacturing process at high temperature cooking and the atmospheric defibering from Mosochiku (Phyllostachys pubescens).
Bull. Govt. Forest Expt. Sta. no. 113: 135-44 (1959). (Jap.)

Laboratory studies on the manufacture of hardboards from a Japanese bamboo (Phyllostachys pubescens) are described. The bamboo chips were impregnated with water, 2% Na_2CO_3 solution, or dilute sulfuric acid (0.5; 1.0; 2.0 %), then cooked at 173°C for 5 to 45 min. After refining, the pulp was formed into sheets and pressed at 180°C and a pressure of 30 kg/cm^2 for 11 min. Pretreatment with dilute sulfuric acid gives boards of good strength, but pulp yield is low. Satisfactory boards and pulp yield are obtained with water-impregnated chips. Water resistance of the boards can be improved considerably by subsequent heat treatment at 150-170°C for 4 hours.

322. Sano, Y., and Nagasawa, S.
Studies on the production of fiberboards from bamboo.
II. On the manufacture of fiberboard from Mosochiku by high-temperature cooking and high-pressure defibering and other experiments.
Bull. Govt. Forest Expt. Sta. (Japan) no. 126: 51-61 (Nov., 1960). (Jap.)

- [illegible]

Fibreboards were prepared from various bamboos and from [illegible] by the high-temperature high-pressure Asplund process. [illegible] were obtained in 20-2[illegible] min. cooking time. The boards showed good strength properties, but water resistance of unsized boards was inadequate; hence the addition of a sizing agent seemed indicated. Nemagaridake (Sasa senanensis Rehd or Sasa kurilensis Makino) gave boards of poorer quality than did Phyllostachys pubescens, Ph. reticulata, or Ph. nigra var. henonis. The last two bamboo species gave products of much lower quality by the Asplund process than when fiberized under atmospheric pressure. Blending with softwood chips reduced the quality of the boards, whereas the addition of hardwood chips was even favorable.

323. Shepardson, R.M.
Composition containing bamboo particles and thermosetting resin.
U.S. pat. 2,[illegible],[illegible]14 (Aug. 4, 1959).

Green bamboo is ground to 16-mesh, dehydrated to 1/[illegible] its original weight, mixed with 20% urea-formaldehyde resin and 1% paraffin wax, and pressed so that 4 in. of the original material is decreased to 7/8 in. thickness after [illegible]0 min at 149° C and 105 kg/sq.cm. The product is useful for mounting electro-typing and engraving plates.

324. Singh, M.M.
Pressed boards from bamboo dust.
Indian Pulp Paper 15, no. 3: 201, 203 (Sept., 1960)

Laboratory experiments carried out at the Indian Forest Research Institute on the manufacture of hardboard from bamboo dust by the wet process are described. Results are not encouraging.

325. Singh, M.M., Jain, H.C., and Sekhar, A.C.
Some investigations on pressed boards from bamboo.
Indian Pulp Paper 23, no. 12: 651-6 (June, 1969).

Experiments on the production of pressed boards from bamboo by the Asplund Defibrator process showed that relatively small changes in steaming temperatures resulted in considerable variations of power consumption and certain mechanical properties. Power consumption dropped markedly with increases in steaming temperature. The following physical properties of the boards were determined: tensile and bending strength, compression parallel and perpendicular to the plane, hardness, water absorptivity, and swelling. Data are given in tabulated form.

Banana stems

(see abstract no. 339)

Cassava stalks

326. **Flaws, L.J., and Palmer, E.R.**
Production of particle board from cassava stalks.
Tropical Products Institute, Report no. G. 34 (1968).

Experiments were carried out in co-operation with the Uganda Development Corporation using 200 lbs. of cassava stalks about 3 feet long and 1 inch in diameter. Splinters were produced under controlled conditions, mixed with urea-formaldehyde resin in a rotary mixer, cold pressed, then hot pressed. The standard panel was compared with B.S. no. 2604:1963 for bending and tensile strength. Results using 6,8 and 10 per cent resin are tabled. It was concluded that good board, slightly exceeding the B.S. can be made with 8 per cent resin, producing a 40 lb/cu.ft. density.

327. Narayanamurti, D., and Singh, J.
Studies on building boards. V. Utilization o tapioca stems and hoop pine bark.
Composite Wood 1, no. 1: 10-17 (Oct., 1953).

Hardboards were prepared from tapioca (Manihot utilissima) stems and hoop pine bark, insulating boards from tapioca only. For disintegration, a lab-scale Asplund Defibrator was used. Pressing into boards was carried out as usual. The resulting boards compare favorably with similar commercial products.

328. Narayanamurti, D., and Singh, J.
Studies on building boards. VI. Preparation of plastics, boards, etc., from wood waste, barks, etc., by thermal treatment in presence of water and by other methods.
Composite Wood 1, no. 4: 89-93 (July, 1954).

A thermal plasticization process on a laboratory scale utilizing different tropical lignocellulosic materials and barks for the manufacture of board and moulded products is described. The results show that products of satisfactory strength and water resistance can be obtained, tapioca wood giving the best results under the conditions employed. A few experiments were also carried out in which tapioca wood or hoop pine bark were either subjected to a mild acid or alkaline hydrolysis or allowed to react with sulfur, phenol, etc., added to the cook.

<u>Coconut husk and coir</u>

(see also abstract no. 270)

329. George, J., and Joshi, H.C.
Complete utilization of coconut husk. I. Building boards from coconut husk.
Indian Pulp Paper 15, no.8: 507-10 (Feb., 1961).

Coconut husks shredded by hand or in a disk mill were pressed into boards at about 150°C and pressures of 3.5 to 155 kg/sq.cm for 30 min. On manual shredding, most of the pith remained on the fiber, whereas disk milling separated the fibers from the pith (60:40 weight ratio). Hardboards from both pith and fiber had satisfactory bending strength which could be improved by addition of a formaldehyde donor, or tar acid-formaldehyde resin. Three-layer boards had particularly good bending strength but, like other insulating and medium-density boards, high water-absorption values too.

330. George, J., and Joshi, H.C.
Complete utilization of coconut husk. II. Hardboards from coconut fiber.
Indian Pulp Paper 15, no. 9: 573-5 (March, 1961).

Hardboards with satisfactory strength properties were prepared from unretted coconut husk and coir shearing waste. To improve the felting quality of the pulps, the fibers were subjected to a softening treatment prior to forming into a mat. Boards from unretted fiber had better strength properties than those from coir shearing waste. The somewhat high water absorption could be reduced to a sufficiently low level by oil tempering or by using suitable sizing agents.

331. George, J.
Complete utilization of coconut husk. III. Particle boards from by-products of the coir industry.
Indian Pulp Paper 15, no. 10: 613, 616 (April, 1961).

The preparation of particle board from coconut husk pith waste and coir shearing waste is described. An aqueous extract of unretted coconut husk, a tannin formaldehyde resin (derived from tamarind seed testa, Bruguiere bark, or tea waste), or a PF resin was used as a binder. The mixture was formed into a sheet, and then pressed at 145°C and 50 kg/sq. cm for 15 min for a 6 mm board. The boards had satisfactory strength and water resistance.

332. George, J., and Bist, J.S.
Complete utilization of coconut husk. IV. Three-layer particle boards with coconut husk particle core.
Indian Pulp Paper 16, no. 7: 437-8 (Jan., 1962).

Wood particles were used for faces, and coconut husk particles for core in the preparation of three-layer particle boards of medium density. The amount of PF resin binder added was relatively minor. Strength and water resistance were within the usual range for medium density particle board. The boards were highly fire resistant, tough, and possessed smooth surfaces.

333. George J., and Shirsalkar, M.M.
Particle board from cocnut husk.
Res.Ind. 8, no. 5: 129 (1963).

334. Iyengar, N.V. R., Anandaswamy, B., and Raju, P.V.
Thermal insulating materials from agricultural wastes: coconut (Cocos nicifera Linn.) husk and pith.
J. Sci. Ind. Research (India) 20D, no. 7:276-9 (July 1961).

The possibility of utilizing sun-dried coconut husk and pith obtained by wet retting for the production of thermal insulation boards has been studied. Insulation boards prepared from different fractions of husk and pith have been found to possess good thermal insulating properties.

335. Jayaratna, S.M.
A possible use for coir dust.
Ceylon Coconut Quarterly 11, no. 3/4: 1-4 (1960).

Brief description of a process development in Ceylon at the Coconut Research Institute for the economical manufacture of moulded articles for many domestic and constructional purposes from coir dust.

336. Krisnabamrung, W., and Takamura, N.
Suitabilities of some Thai hardwoods and coconut fiber for manufacturing hardboards by wet and dry process.
J. Jap. Tappi 22, no. 3: 154-64 (March, 1968).

Experimental studies are reported of the manufacture of hardboard by wet and dry process from coconut (Cocos nicifera) fiber and 7 Thai hardwoods. The Asplund Defibrator process was used for defibration. Phenolic resin and paraffin were added to the fiber furnish in amounts of 0.5% for the wet and 4 % for the dry process. With the exception of two hardwoods, all raw materials examined yielded hardboards meeting the specifications of Japanese industrial standards. Boards from coconut fiber showed outstanding flexibility superior to that of wet-process hardwood boards.

[illegible]

[illegible] ... made from coconut [illegible] ... with various additives (e.g. [illegible] ... followed by hot-pressing for [illegible] ... physical properties [illegible] ... resistance, [illegible] etc. [illegible]

[illegible], R.K., Narayana, [illegible]

[illegible] utilisation of coconut [illegible]

[illegible] (July, 196[illegible]).

[illegible] were made from coconut coir pith or [illegible]. Board properties (density, modulus [illegible], water absorption, [illegible] were determined as a function of [illegible]. Temperatures of 150-1[illegible]0°C and pressures of [illegible] were found to be optimum. The influence of tempering on [illegible] [illegible].

[illegible]. [illegible], [illegible], [illegible], R.K., and George, J.
Fire-resistant building boards from coconut pith.
[illegible] J. (Bombay) 1[illegible], no. 7: 12-14 (19[illegible]).

Fire-resistant lightweight building boards suitable for insulation and as expansion joint filler are produced from unretted coconut pith by felting with wood fibres or [illegible] fibers. The pith is mixed with pulp and water to give a 3-4 % slurry, the pH is adjusted to 4-5, a paraffin wax or rosin-paraffin wax (83:17) emulsion is stirred in for 5 min. as a sizing agent, and the size is precipitated by adding an alum solution.

340. Hadinoto, R.C.
Coconut husk as a new raw material for board production in copra producing countries.
South Pacific Commission, Tech. Infor. Circular No. 25: 1-10 (July, 1957).

In Indonesia during 1951 plans were drawn up to start producing hardboard to meet the increasing demand for sheet materials necessary for housing. Coconut husks were chosen as the raw material. In East-Java, a pilot plant with a production capacity of 3,500 tons of board annually was erected. The German C.T.C. process has been chosen because it appears to be economical for medium and even small-sized units. In addition it is suited for producing a great variety of boards.

341. Tropical Products Institute.
Attempts to use coir dust in the preparation of building slabs on hardboard.
Tropical Products Institutes, Report no. G. 35 (1968)

Coir dust of two distinct particle size distributions were mixed with cement in ratios of from 1:1 to 6:1 cement/coir dust which only produced concrete of load-bearing qualities when extra water was added to the coir. The cement faction was then increased to what was considered uneconomic levels before adequate concrete was produced. Non-loadbearing panels of 40, 60, 70 and 80 lbs/ft^3 were also produced but with difficulty. Hardboard production required both excessive pressures and resins and was also considered unpromising.

Coffee husks

3[..]. [..] Products Institute.
Manufacture of particle board from coffee husks.
TPI Report no. [..] (19[..]). [..] p.

Particle boards 0.5 thick were prepared from coffee husks, from a mixture of coffee husks and cotton seeds, and from a mixture of coffee husks and groundnut shells. UF resin in varying amounts was used as a binder. The material was formed into a mat pressed at 140°C for 10 min at pressures ranging from 30 to 300 psi. Increased resin content and increased density both resulted in improved board strength and water resistance. Boards containing 1[..] resin and having a density of 1.[..] exceeded the British standard minimum strength. Mixtures of coffee husks with other waste materials gave boards of lower strengths than coffee husks alone.

Corncobs

(See also abstract no. 255)

3[..]. Demirel, T.
Acid-treated corncob construction material and method of producing same.
U.S. patent 3,[..]01,[..]00 (Jan., 19[..]).

A process of making wallboard or the like construction board comprises contacting a batch of corncobs with a phosphoric acid solution of 20-30% concentration at [..]-110°C, withdrawing the phosphoric solution from the digested corncob product, reducing the particle size of the corncob product to a fine texture, mixing the fine-textured product with a resin-forming liquid, shaping the mixture, and curing at elevated temperature. The resin-forming liquid includes furfuryl alcohol spent sulfite liquor, and phosphoric acid.

3[..]. Fattah, A., and Rahman, S.M.F.
Studies on the thermal and electrical insulation properties of boards made from waste materials indigenous (to Pakistan).
Sci. Ind. (Pakistan) 4, no. 1 : 31-40 (Jan., 1966).

Studies of the thermal and electrical properties of boards made from waste material (jute sticks, jute cutting waste, corn husk, and sawdust) indigenous to Pakistan are reported. The waste materials were mixed in various combinations and proportions with a PF binder and pressed at 130°C and a pressure of 800 psi for 15-20 min. Most boards obtained showed thermal and electrical insulation properties comparable to those of commercial boards.

3[..]. Rao, Ramachandra, K.
Utilization of corn-cobs for manufacture of plywood.
Indian Forester 91, no. 6: 405 (1965).

Insulating-type building boards are made from corn-cobs by cutting the cobs into transverse sections of required thickness and forming the sections into a slab covered on both sides with a veneer. The product obtained is lighter and cheaper than ordinary plywood.

Cotton stalks and cotton seed hulls

(See also abstract no. 255; 264; 270; 342)

346. Mandavi, E.
Economic and technical aspects of harvesting cotton stalks for the production of particle board.
ID/WG.83/11. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 7 p.

Cotton stalks are used for the production of particle board at a plant established on a 5,000 acre farm near Gorgan, Iran. A brief description is given not only of methods for harvesting cotton stalks, as indicated by the heading, but also of storage procedures, and of the manufacturing process used at the plant. Since boards made from cotton stalks show a dark brown color and moderate strength, at least fifty percent of the stalks are substituted for poplar chips to improve appearance and physical properties.

Flax and hemp shives

(see also abstract no. 255; 259; 264; 270;287;292)

347. Barthel, R.
Utilization of by-product flax shives for fiber boards.
Faserforsch. u. Textiltech. 12, no. 11: 534-47 (Nov., 1961). (Ger.)

Flax shives constitute about 37% of the harvested yield of the flax plant. Experiments have demonstrated that fiberboards with satisfactory properties comparable to those of wood-particle and wood--fiber boards can be made from this agricultural waste. The manufacturing process includes sorting and cleaning of the flax chaff, pressure-steaming, defibration in a disk mill, sheeting of the processed shives by a wet process, and molding in a hot-press with or without addition of PF resin adhesive into fiberboards ranging in density from less than 0.25 to 1.0 g/cu.cm.

348. Bentsianova, I.Y., Veksler, G.M., Markov, L.R., Melamed, S.N., and Petrienko, P.M.
The manufacture of wood-particle board from hemp scutch.
Derevoobrabat. Prom. 11, no. 4: 9-10 (April, 1962). (Russ.)

A description is given of a manufacturing process for wood-particle board from wood alone, wood and hemp (and/or flax) scutch, or from scutch alone. In the case of mixed boards, the internal layer is made of wood particles, the outside layers of hemp scutch cleaned of fibers and dust. UF or PF resins are used as binders, and the boards are moulded at 135-140°C and a pressure of 14-20 kg/sq.cm. The process is to be introduced shortly at one of the large furniture plants of the Ukraine.

349. Eisner, K., and Kolejåk, M.
Building board from flax and hemp fibers.
Drevo 13, no. 12: 356-60 (1958). (Pol.)

Experimental boards were prepared from flax and 9% UF resin binder. The mixture having a moisture content of 6 % was pressed at 160°C for 6 min. The density of the boards was 0.[illegible]0-0.65 g/cu.cm. Boards of lesser density (e.g. 0.16 g/cu.cm) can be produced as well. Hemp fibers required only 7.5% binder. As compared with wood-particle board, boards from flax and hemp are more economical, but show much higher swelling in water.

350. Frackowiak, A., and Lawniczak, M.
The effect of the waterproofing impregnating agent GSE-10 on some properties of flax waste boards.
Przemysl Drzewny 12, no. 11: 8-9 (Nov., 1961). (Pol.)

A new waterproofing agent developed at the Institute of Wood Technology in Poznan was found to reduce the hygroscopicity of flax waste boards by 30%, their swelling by 40%, and to increase their bending strength markedly.

351. Gradovich, V.A.
Prospects for the expansion of the manufacture of constructional boards from flax waste.
Proizv. Stroit. Izdelii iz Plastmass, Sb., 1963: 73-80. (Russ.)

A process for the manufacture of insulation boards from flax chaff is described. The chaff is beaten to a freeness of 14°SR, sized with a rosin-paraffin size, and mixed with 0.2% of a fungicide (Na_2SiF_6). The fibrous suspension (consistency of 1-1.2%) is formed into sheets, and the sheets are pressed and dried. The finished products have a specific gravity of 0.18-0.22 g/cu.cm, a bending strength of 6-12 kg/sq.cm, a 2-hr maximum water absorption of 20%, and a heat conductivity of 0.047 kcal/m/hr/°C.

352. Hadnagy, J.
Examination of some problems in flaxboard production technology.
Faipar Kutatások, Vol. 2: 77, Budapest 1964. (Hung.)

353. Klauditz, W., Ulbricht, H.J., and Kratz, W.
Production and properties of lightweight wood-shaving boards.
Holz Roh-u.Werkstoff 16, no. 12: 459-66 (Dec., 1958). (Ger.)

Particle boards having densities of 0.3-0.5 g/cu.cm were prepared from softwoods and hardwoods, and from flax straw. About 6.9% UF resin was added as a binder. The boards showed strength properties that made them appear suitable for various commercial applications.

354. Kolosvary, G.
Increasing the water resistance of wood-particle and hemp waste boards by preliminary thermal treatment of the particles.
Fairpar 15, no. 2: 46-9 (1965). (Hung.)

Hemp waste and poplarwood particles were heated to 160, 200, 210, and 235°C by means of a stream of hot gas. Particle boards made from the pretreated materials showed lower water absorption and lower thickness swelling after soaking in water or after exposure to supersaturated water vapor for 10 days than boards obtained from untreated materials. Strength properties, however, were the same with both types of board.

355. Lawniczak, M., and Raczkowski, J.
The physical and mechanical properties of boards from flax waste.
Derevoobrabat. Prom. 11, no. 10: 77-8 (Oct., 196[illegible]) (Russ.)

Building boards from flax shives are produced in Poland in two density ranges, 500-700 and 300-400 kg/cu.m., the latter being used as insulation panels. After thorough cleaning the shives are formed into boards using a thermosetting UF resin as a binder. The water absorption of flaxboard is lower than of wood-particle board and can be further reduced by the addition of a recently developed water-proofing agent. The elasticity modulus and bending strength are comparable to those of wood-particle board of the same density. The special advantages of flaxboards are their high thermal and sound-insulating properties.

356. Lawniczak, M. and Raczkowski, J.
Particle boards made from flax and hemp shives.
Drvna Industrija 14, no. 9/10: 139-46 (1963) (Croat.)

The process used at the Vitasicama mill in Poland for the production of particle board from flax and hemp waste is described in some detail. Dust and fibres amounting to about 25 % of the raw material are removed pneumatically before mixing the shives with urea-formaldehyde resin and a waterproofing agent. The mixture having a moisture content of 12 % is then formed into a mat and pressed at 140-150°C. The pressing time depends on the thickness and density of the board (e.g., 14 min for a 20-mm board of 500 kg/m³). For use in structural applications and furniture, boards with a density of 700, 600, and 500 kg/m³ are produced. Minor quantities of lighter boards (300 and 400 kg/m³) are also produced yielding a suitable isolation material . The physical and mechanical properties (water absorption, thickness swelling, modulus of elasticity, hardness, thermal conductivity, and sound-absorbing properties) of the hemp boards compare well with those of boards made from wood.

357. Mestdagh, M., and Demeulemeester, M.
The manufacture of phenolic-resin-bonded flax-particle board for the construction industry.
Holz Roh- u. Werkstoff 28, no 6: 209-14 (June, 1970). (Ger.)

The structure, chemical composition, and mechanical strength of flax shives and flax boards were compared with corresponding properties of wood-particle boards. No significant differences preventing the production of phenolic-resin-bonded flaxboard were observed. Two types of board, either with or without the addition of supplementary caustic soda, were produced both meeting the specifications of German Standard DIN 68 761.

358. Narayanamurti, D., and Singh, J.
Note on hardboards from linseed fibre.
Indian Pulp Paper 17, no. 5: 302 (Nov., 1962).

Linseed fibers were pulped with varying concentrations of NaOH, defibered in a Condux mill, and pressed into board. Difficulties encountered in the defibration of the long-fibered material were eliminated by cutting the linseed fibers to shorter lengths. The properties of the tempered boards proved to be satisfactory.

359. Nico, R., and Cremaschi, J.
Quebracho tannin-formaldehyde adhesive for particle board.
Rev. Soc. Quim. Mex. 5, no. 3: 98-103 (May 1961). (Span.)

The manufacture of particle board from poplarwood and flax fibers using quebracho tannin-formaldehyde adhesive as a binder resulted in a board with properties approximating or superior to those of similar boards using UF resin adhesives. The cost of the tannin-formaldehyde adhesive is less than half of that of UF resin adhesives.

[illegible]

[illegible]
[illegible] waste for the [illegible]
[illegible]
Przemysl [illegible], 19[illegible], No. [illegible]

361. [illegible]
[illegible] boards from flax waste.
[illegible] (19[illegible]). (Czech.)

A plant for the manufacture of building boards from flax waste is under construction in Vesela, Czechoslovakia. The manufacturing process is described, and the applications of the Linex boards in construction are discussed and illustrated.

362. Skory, [illegible]
Method of improving some physical properties of flaxboard.
Przemysl Drzewny 20, no. 1: 12-13 (Jan., 19[illegible]). (Pol.)

The possibility of improving the water resistance of flaxboard by incorporating a special paraffin emulsion into the fibrous material was investigated. It was found that both water absorption and swelling in water decreased considerably with increasing paraffin content of the boards. Optimum values were obtained with boards containing 0.7% of the water-proofing agent. Further increasing the paraffin content resulted in products of lower strength.

363. Skrigan, A.I., Shishko, A.M., and Ileskin, [illegible].V.
Utilization of pinewood stumps and flax fibers for the manufacture of thermal insulation panels.
Vestsi Akad. Navuk Belarus. S.S.R., Ser. Fiz.-Tekh. Navuk no. 1: [illegible]-33 (1958). (Russ.)

The addition of 25% flax fibers to stump wood improves the strength properties and increases the hardness of insulation board. Joint beating of wood and flax fibers is recommended. The properties of the board comply with standard requirements.

364. Swiderski, J.
Technology of flaxboard manufacture.
Holz Roh- u.Werkstoff 18, no. 7: 242-50 (July, 1960). (Ger.)

This is a well-illustrated description of the technology of flaxboard manufacture, in particular of the facilities and operations of a recently constructed mill in Poland. Compared with the manufacture of wood-particle boards, the processing of flax shives requires no chipping; much less drying power; no press forms; and no metallic pallets, but on the other hand better cleaning; more careful moisture control; twice as much preforming pressure; and a more rugged hot-press design.

365. Tomásek, L.
Flax shive particle boards.
Drev. Výber 15, no. 6: 49-54 (1962). (Czech.)

366. Verbestel, J., and Kornblum, G.
Particle boards from flax. Part I. Utilization of agricultural by-products. - Part II. Industrial experience in the use of flax straw for the manufacture of particle boards. FAO/ECE/BOARD CONS/Paper 4.16. Fiberboard and Particle Board. Report of an International Consultation on Insulation Board, Hardboard, and Particle Board, Geneva, 1957.

The first part of this conference paper deals with the availability and utilization of agricultural by-products, especially of flax straw. In the second part, the industrial experience in the manufacture of flaxboards gained in the course of more than 20 years is reviewed.

367. Wielexco Ltd.
Flaxboard production in Belgium - The new Wielexco mill.
Board 4, no. 12: 286-9 (1961).

Grasses

(see also abstract no. 259; 316)

368. Narayanamurti, D., and Singh, K.
Note on hardboards from Kans grass (Saccharum spontaneum).
Indian Pulp Paper 17, no. 5: 301 (Nov., 1962).

Hardboards of satisfactory properties were made experimentally from Kans grass (Ekra) by pulping the grass with caustic soda (0.05 and 0.5%), lime (0.1 and 0.3%), or plain water, all mixed with the grass in a 1:20 ratio and boiled for 2 hours. The 0.3% lime treatment produced the best board with a modulus of rupture of 543 kg/sq.cm., but gave the lowest pulp yield (45%).

369. Narayanamurti, D., and Singh, J.
Boards from Phragmites karka.
Indian Pulp Paper 17, no. 7: 437 (Jan., 1963).

The manufacture of thermodyne disks, chip boards, and fiber boards from Phragmites karka material and the properties of the products are described. The chip boards (10% UF resin) had a density of 0.565-741 g/cu.cm. and a tensile strength of 73-100 kg/sq.cm. High--strength fiber boards were produced from $Ca(OH)_2$-cooked pulps, while boards with good moisture resistance were produced with NaOH cooking. Oil (linseed) tempering improved both properties considerably, more so than simple oven tempering.

370. Singh, M.M., Rana, R.S., and Sekhar, A.C.
Pressed boards from Ulla grass (Themida arundinacia).
Indian Pulp Paper 19, no. 7: 443, 445-7 (Jan., 1965).

Ulla grass was processed (chopped, screened, soaked, steamed), defibered in an Asplund defibrator, washed, and the wet fibers pressed into fiberboard at 35 kg/sq.cm. for 5 min. The board was subsequently dried at 130°C and a pressure of 31.7 kg/sq.cm. for two hr. Strength properties of the boards obtained compare favorably with those of commercial fiberboards. The effect of steaming and defibering time on the board properties are discussed.

Groundnut shells

(see also abstract no. 264, 232, 342)

371. Chittenden, A.E., and Palmer, E.R.
The production of particle board from groundnut shells.
Board 5, no. 6: 102-105 (1962).

Single layer particle boards were produced experimentally using groundnut shells and urea-formaldehyde resin. The range of strength characteristics from the several densities and resin content levels were quite wide. Very fine particles (passing a BS 22 mesh sieve, 0.0275 inch aperture) were excluded as they used excessive resin. A board of about 40 lbs. per cu. ft. was chosen as a typical sample. Pressures used to produce boards of densities from 35 to 50 lbs. per cu.ft. ranged from 160 to 580 lbs. per sq.m. The boards were found to be difficult to sand but this was said to be soluble by making a 3-layer board. Otherwise it was workable with normal tools. A cost summary is included based on West African prices. Samples were compared with BS2604:1966. Data are tabulated by resin content and density for various characteristics.

372. Chittenden, A.E., and Palmer, E.R.
The production of particle board from groundnut shells.
Board 7, no. 8: 183-7 (Aug., 1964).

Particle boards were made experimentally from groundnut shells. The fraction of shells retained on a 3/16-inch sieve was used as the core and an equal weight of the fraction which passed through the sieve was used as the surface layers. The effects of different resin formulations, modifications of the manufacturing technique, addition of fungicides and wax, and other parameters were investigated. The tests were conducted on boards having a density of 0.64 g/cu.cm and containing 8% UF resin. Variations of manufacturing techniques and changes in resin formulations had little effect on board strength. However, pressing without a frame resulted in boards of better strength properties than when using a frame. The most effective fungicide tested was Na-pentachlorophenate. The addition of wax improved the dimensional stability of the boards when stored at high humidities, but had only little effect on water absorption when the board was immersed in water.

373. Chittenden, A.E., and Palmer, E.R.
Particle board from groundnut shells.
Board 8, no. 3: 75-92 (March, 1965).

Investigation of the full-scale plant production of particle board from groundnut shells showed that a conventional plant designed for use with wood particles required modification, particularly in the methods used for removing extraneous materials and dust, and in eliminating processing steps where groundnut shells could be reduced to powder. Details of a plant taking these factors into account are presented. Boards produced were tested for strength, water absorption, aging effects, etc., and the results are tablulated. Tungsten carbide-tipped saws were required to trim the boards. The economics of utilizing groundnut shells for particle board manufacture are discussed.

374. Digard, R.
Particle boards from groundnut shells.
Oléagineux 22, no. 6: 405-7 (June, 1967) (Fr.)

Attempts have frequently be made to utilize the groundnut shells, which constitute up to 25 % of the weight of the total nuts. This article describes the quite successful manufacture of particle board. After shredding, removing of dust and cleaning, the particles are mixed with a thermosetting resin, and then pre-formed. Hot pressing is done continuously. The boards obtained show satisfactory strength properties and are highly resistant to termites and moulds. A board factory needs an annual supply of at least [illegible],500 tons of shells.

375. Jain, N.C., Gupta, R.C., [illegible], S.C., and Singh, [illegible]
Utilization of groundnut shells.
Indian Pulp Paper 18, no. [illegible]: 377-[illegible] (Feb., 1964).

Results of investigations on the utilization of groundnut shells for hardboards, particle boards, and building boards, and as a filler extender in synthetic resins are presented.

376. Jain, N.C., Gupta, R.C., and Jain, D.K.
Particle boards from groundnut shells.
Indian Pulp Paper [illegible], no. [illegible]: 345-[illegible], [illegible] (Dec. [illegible]7)

Laboratory experiments on the manufacture of particle boards from groundnut shells are reported. The shells were freed from dust, sprayed with suitable resins, formed into a mat, cold-pressed, and then hot-pressed. No sizing agents (e.g. paraffin wax) were added. The time and temperature of pressing depended on the type of binder used and the thickness of the board. The physical properties (modulus of rupture, tensile strength, water absorption, etc.) of the boards were satisfactory, except water absorption which was rather high. Data are tabulated.

377. Tropical Products Institute.
Notes on the design factors in the production of a particle board plant to utilise groundnut shells.
Tropical Products Institute, Report no. 29 (1962).

Jute sticks

(see also abstract no. 259, 264, 270, 287, 344)

378. Banerjee, S.P., and Saha, P.K.
Particle board from jute stick.
Contribution to the Annual Report of the Technological Research Laboratories for 1962-63. Calcutta, Indian Central Jute Committee, 1964. 4 p.

The manufacture and properties of particle boards from jute sticks are described.

379. Far Eastern Economic Review.
Hardboard from jute sticks.
Far Eastern Economic Review 36, no. 8: 434 (May 1962).

India has begun producing hard paperboard from jute sticks at two Calcutta paper mills. The board is claimed to be a superior quality product of high bursting and folding endurance, suitable for making box-boards. The manufacture of building board from jute sticks has not yet been considered.

380. Narayanamurti, D., and Kohli, R.C.
Boards from jute sticks.
Board Manufacture 4: 122-3 (May 1961).

381. Narayanamurti, D., and Singh, J.
Plastic boards from jute sticks.
Board Manufacture 5: 199 (Nov., 1962).

[illegible]. Saha, P.L., and Basak, K.K.
Asphalted roofing material from jute stick.
Jute Bull. [illegible], no. 1: 8-[illegible] (April, 1964).

A board made from about [illegible] % jute stick pulp, 41 % waste paper, and [illegible] % hosiery cuttings was recently developed by the Technical Research Laboratories of the Indian Central Jute Committee at Calcutta. The quality of the board, either untreated or after dipping in hot asphalt, compared favourably with similar imported boards. Like these, it may be used after proper surfacing as a roofing material.

Kenaf

(see abstract no. [illegible]70)

Mustard stalks

383. Narayanamurti, D., and Kohli, R.C.
Hardboards from mustard stalks.
Indian Pulp Paper 16, no. 6: 379 (Dec., 1961).

Hardboards were made from mustard stalks using lime or caustic soda as the cooking medium. The strength properties of the boards were inferior to those of boards made from jute sticks, and their moisture absorption was rather high. Some of the boards, however, were satisfactory. On the whole, best results were obtained with the lime-cooked material.

Palm leaves and palm fruit stems

(see abstract no. 255; 264; 270)

Papyrus

(see also abstract no. 255)

384. Lewin M., and Lengyel, A.
Papyrus as a raw material for the production of insulation board and hardboard.
FAO/ECE/BOARD CONS/Paper 4.14. Fiberboard and Particle Board. Report of an International Consultation on Insulation Board, Hardboard and Particle Board, Geneva, 1957.

Insulating board and hardboard have been made from papyrus both on a laboratory scale and in a pilot plant run in Israel. Physical properties of the boards were satisfactory.

385. Lewin, M., and Lengyel, A.
Papyrus as a raw material for the production of insulation and hardboard.
Bull. Research Council Israel 6C, no. 3: 181-96 (Aug., 1958).

Insulation and hardboard were made from Israeli papyrus having 37.5 % rind, and 29.5% pith. Suitable pulps were obtained by cooking with water at 150°C and a fiber: liquor ratio of 1:1, and subsequent refining in disk refiners. The refined and screened pulp was sheeted on an Oliver forming cylinder at 10 f.p.m. and dried at 165-170°C in a Coe drier to give insulation board. For the manufacture of hardboard, the wet mat was hot-pressed at 200°C and 100 kg/sq.cm for 6 min. The boards met British Standard specifications.

Peat

386. Lishtvan, I.I., and Meshalkin, G.V.
The mechanism of quality improvement of peat heat-insulation boards by thermal treatment.
Izv. Vysshikh Ucheb. Zavedenii, Stroit, Arkhitekt. 9, no. 9: 61-66 (1966). (Russ.)

The possibility of improving the quality of insulation boards made from peat of low degree of decomposition was studied. Boards prepared by the standard wet process were subjected to thermal treatment by heating them under atmospheric pressure or reduced pressure for up to 2 hr at 100-200°C. The 24-hr water absorption decreased with increasing temperature and time of treatment. After 2 hr. treatment at 160-180°C, water absorption was reduced from the initial 337% to 70-75%. As shown by chemical analysis, the improvement was due to decomposition of hydrophilic peat components (pectins, hemicelluloses, fulvic acids, etc.) and, evidently, to the formation of new chemical bonds as a result of decomposition. The recommended temperature and time for heat treatment are 170-190°C and 1.5- 2 hr.

387. Milukas, A.
Use of vibration for manufacture of insulating board from peat.
Mokslas ir Tech. no. 1: 25-6 (1966). (Lithuanian)

Board prepared from peat by pressure is not homogeneous and has poor mechanical properties. The use of vibration in forming of peat board improved its mechanical properties, decreased its water absorption, and slightly increased its density.

388. Skrigan, A.I., Shimanskii, V.S., Zhuk, E.A., and Shadurskii, P.A.
Utilization of peat of low degree of decomposition for the manufacture of building boards.
Khim. i Genezis Torfa i Sapropelei, Akad. Nauk Beloruss. SSR, Inst. Torfa, 1962: 249-52. (Russ.)

Peat, with a 20-25% degree of decomposition, was pulped by the NSSC process for 3 hours at 120°C, and the pulp obtained was used for the manufacture of heat insulation boards. Because of dewatering difficulties, high amounts (65 and 95%) of fiberized wood had to be added to the peat pulp. Results of strength tests indicated that the density and mechanical strength of the boards increased with increasing amount of peat pulp. Boards containing 5% peat pulp had a bending strength of 169 kg/sq.cm, those containing 35% had a bending strength of 230 kg/sq.cm.

389. Volkov, B.P., and Maizenberg, M.M.
The utilization of peat in the manufacture of wood-particle board.
Torf. Prom. 40, no. 6: 28-9 (1963). (Russ.)

Investigations at the Kalinin Institute of Peat demonstrated that peat, containing a large fraction of humic substances, when peptized with NaOH solution, has good properties as a binder, especially when a small amount of resol resins is added to the composition. The preparation of the binder is described. The liquid binder, containing 23% solids, is added in an amount of ... kg/cu.m. wood-particle board. The strength properties of the boards and their water resistance comply with standard requirements.

390. Wochenblatt für Papierfabrikation.
Peat, a noteworthy raw material for the board industry and hardboard manufacture.
Wochbl. Papierfabr. 92, no. 1: 4-5 (Jan., 1963). (Ger.)

The costs involved in obtaining and processing peat so that it can be used as a raw material in board manufacture are outlined.

Ramie

(see abstract no. 270)

Rape straw

(see also abstract no. 292)

391. Kilanowski, W.
Economic and technical aspects of the processing of rape straw into particle boards.
ID/WG.83/13. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 16 p.

(see abstract no.269)

392. Kontek, W., and Lawniczak, I.
The utilization of rape straw in the manufacture of insulation board.
Przemysl drzewny no. 10: 16-18 (1959). (Pol.)

Preliminary experiments showed that the quality of insulation board made from sawdust, shavings, and reed is improved by the addition of rape straw. Board containing rape fibers has a lower water absorption and reduced swelling.

393. Lampert, H.
Modification of the properties of hard fiberboards through unidimensional shaping.
Zellstoff u. Papier 8, no. 10: 378-80 (Oct., 1959). (Ger.)

The strength properties of low-quality hardboards made from rape-straw can be improved by appropriate aftertreatment with water, heat, and pressure. Rape-straw fiberboards were stored in water of 17°C for 1 to 230 min, the treatment increasing the moisture content to 9-24%, and then pressed in a laboratory hot press at 195°C and 40 kg/sq.cm. for 12 min. Bending strength increased by about 25%, whereas board thickness decreased from 4.5 to 3.5 mm. Best results were obtained at 15% moisture content.

394. Lampert, H.
Manufacture of fiberboards from rape straw.
Holztechnol. 1, no. 1: 15-22 (July, 1960). (Ger.)

A detailed description is given of the manufacture of fiberboard from rape straw, including handling, cleaning, and chopping of the raw material, pulping by the Asplund-Defibrator process at 175-180°C, refining to 11-14°SR, and hot-pressing at 180-195°C and a final pressure of 40 kg/cm² for 18 min. The effects of some operating variables on thickness swelling and bending strength were investigated. In addition, the morphological and chemical characteristics of rape straw, and the changes of chemical composition during storage are reported.

395. Wnuk, M.
Properties of rape straw board produced in Poland.
Holztechnol. 6, no. 1: 64-7 (Feb., 1965). (Ger.)

Rape straw was substituted for flax on an experimental basis in a commercial particle board manufacturing line in Poland. Boards with a density below 0.6 kg/cu.cm showed high thickness swelling and water absorption, and were found to be unsuitable for use in furniture. Boards with a density above 0.6 kg/cu.cm had a bending strength somewhat lower than corresponding flax shive boards. Other properties of the boards, such as thermal conductivity, fungal resistance, screw holding power, and workability were satisfactory. Disadvantages of using rape straw include high binder consumption, lack of abundance of raw material, and difficulties of storing rape straw without decay.

Reeds

(see also abstract no. 255; 264;292 ; 392)

396. Badanoiu, G., and Oradeanu, T.
Utilization of reed residues for particle-board manufacture with synthetic binders.
Celuloza hirtie 7, no. 3: 103-7 (March,1958). (Rom.)

Comminuted reed wastes, remaining after acid treatment for production of furfural, are neutralized, dried to 6-10% moisture content, and mixed w'th 6-10% UF resin binder and 6% paraffin. The material is then pressed into boards at 140-150°C and 10-15 kg/sq.cm for 10--20 min. The resulting particle boards having a density of 0.674 g/cu.cm are claimed to be comparable in properties to boards made from wood. Some data on the consumption of water, heat, and electric energy are given.

397. Federowicz, G.
Fiberboards from reed.
Przeglad Papierniczy 14, no. 4: 125-6 (April, 1958). (Pol.)

398. Huminski, K., and Werba, K.
Light panels and their manufacture.
Pol. pat. 39,112 (April 10, 1956). (Pol.)

Light panels or tiles for use in constructions as heat- and sound-insulating material are made from stems and leaves of reed. The manufacturing method consists of packing straightened stems and leaves into alternating crosswise and lengthwise layers, impregnating the material with a binder, and hot pressing into multi-ply sheets of various hardness and thickness.

399. Kolesnikov, E.A.
Properties and utilization of powdered reed wastes.
Khim. Pererabotka Drevesiny, Sb. 30: 5-6 (1963). (Russ.)

Morphological and chemical analyses were made of powdered reed waste obtained from a reed-processing board mill. The waste consisted of 7.4% fibers, 46.2% fine particles (0.1-2.5 mm), and 46.4% dust. The material was used for the manufacture of insulation boards containing no binder. The experimental boards were of standard quality.

400. Mudrik, V.I.
Reed processing plants.
Bumazh. Prom. 35, no. 8: 6-10 (Aug., 1960). (Russ.)

Various reed-processing plants are under construction in regions of the USSR where reed is abundant. The plant at Astrakhan will produce large amounts of semichemical pulp, board and corrugating medium, and 5 million sq.m. of building board. A description is given of mechanized harvesting and transportation of reed, pulping processes, and board manufacture.

401. Narayanamurti, D., and Singh, K.
Utilization of dust from reeds of Ochlandra travancorica.
Indian Pulp Paper 17, no. 8: 487, 489 (Feb., 1963).

Reed rejects from 20-mesh screen were used for the experimental manufacture of particle board, fiber board, sawdust board, and thermodyne disks. The particle boards were bonded with PF resin at 150°C and a pressure of 28 kg/sq.cm for 12 min. For the production of fiberboards, the raw material was cooked with lime or NaOH, fiberized, and pressed at 52 kg/sq.cm and 160°C for 25 min. The sawdust boards were prepared from a mixture of reed dust and "activators", e.g., shellac. Most of these boards had satisfactory strength properties.

Rice husks and rice straw

(see also abstract no. 264; 412)

402. Chittenden, A.E., and Flaws, L.J.
The use of rice hulls as aggregate in lightweight concrete.
Tropical Science 6, no. 4: 187-199 (1964).

Rice husks can be used successfully as an aggregate in the preparation of lightweight concrete. For non-load bearing internal partitions, it is sufficient to press the mix by hand, but when the concrete is to be used for load bearing outdoor structures, then the mix must be compressed during setting and the concrete rendered. The cement/husks ratio was varied from 2:1 to 10:1 corresponding to a density range of the concrete of 25-115 lb/cu. ft. It appeared that with a density approaching 100 lb/cu.ft the concrete had adequate strength for most structural purposes.

403. Guha, S.R.D., Mathur, G.M., Gupta, V.K., and Sekhar, A.C.
Insulating board from rice straw.
Indian Pulp Paper 19, no. 10: 633, 635 (April, 1965).

Insulating boards were produced on a lab scale from rice straw by the Asplund process. Test results indicate that boards with satisfactory properties can be manufactured from this raw material.

404. Industrial and Engineering Chemistry.
Tecpan - a new "home-grown" building material will solve South Korea's housing problems.
Ind. Eng. Chem. 52, no. 4: 28-9A (April, 1960).

Studies are described of the manufacture of building boards from rice straw using sodium silicate as a binder. Panels of varying thickness and sizes can be produced. The material is light but structural strength is high. It is resistant to vermin and moisture, and has insulating and sound-proofing qualities.

405. Institute of Wood Technology.
Investigations on the manufacture of hardboards from rice straw.
Final Report no. AE 1-41/O. Institute of Wood Technology, Dresden, October, 1961. 30 p. (Ger.)

In the manufacture of hardboard from rice straw, thorough cleaning of the raw material and careful defibration is essential to the development of optimum physical properties of the end product. Experimental boards were produced on a laboratory scale by the wet process using 3% by weight of a synthetic resin as an additional binder. After heat-treatment at 160°C for 2 hours, the boards exhibited satisfactory physical properties complying with standard specifications. Trials on a full commercial scale gave less satisfactory results, however.

406. Jain, N.C., Gupta, R.C., and Bajaj, S.C.
Building board from paddy husk.
Board Manufacture 7, no. 3: 72 (1964).

407. Jain, N.C., Gupta, R.C., and Bajaj, S.C.
Plastic boards from paddy husk.
Res.Ind. (New Delhi) 9, no. 3: 67-9 (1964).

Paddy husk was cooked in the presence of various chemicals under different cooking conditions, and the material obtained was used for the production of boards. Cooking with cresol gave boards of superior strength while aniline gave boards of lowest water absorption. The best results were obtained with a cooking time of 30 min. at 195°C and addition of furfuraldehyde before pressing. Replacing

20-30% of the paddy husk by jute sticks and adding 10% phenol and/or sodium hypothiosulfate (based on the weight of paddy husks and jute sticks) resulted in boards of higher strength.

408. Narayanamurti, D., and Kohli, R.C.
A new extender for adhesives from rice husks.
Kunststoffe 49, no. 6: 269-70 (June, 1959). (Ger.)

Rice-husk meal and the gel obtained from the alkaline extract of rice husks by acidification were found to make excellent extenders for phenolic wood-laminating resins. The residue from the alkaline extraction can be used, after addition of 12-15% phenolic resin, as a binder in the manufacture of hardboard from rice husks and related agricultural wastes.

409. Vasishth, R.C.
Water resistant composite board from rice husks.
ID/WG.89/23. Joint UNIDO, FAO, ECAFE Interregional Seminar on the Industrial Processing of Rice. Madras, India, 11-16 October, 1971. 9 p.

In general, rice husks are considered to be unsuitable for the production of particle board due to their high silica content, short fiber length, and low resistance to alkali. Studies carried out recently have demonstrated, however, that satisfactory boards can be produced from the husks if a specially prepared phenol-formaldehyde resin is used as a binder. The rice husks were sprayed with 8% by weight of the new resin, then formed into a mat, and pressed at 154-210°C for 8-20 min. For boards of 1.59 cm thickness, pressing times of 7 min at 210°C, or 12 min at 177°C were found to be adequate. Some physical properties of the boards are reported.

Sisal

(see also abstract no. 270)

410. Narayanamurti, D., and Singh, J.
Hardboard from sisal fibre.
Board Manufacture 5: 133 (Aug./Sept., 1962).

Straw

(see also abstract no. 264; 310)

411. British Stramit.
The story of British Stramit.
Board 5: 8-11 (Jan., 1962).

412. Bulakul, S.
Economic and technical aspects of the utilization of cereal stalks for the production of panels.
ID/WG.83/10. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 39 p.

Economic and technical aspects of the production of straw slabs by the "Stramit" process are discussed, including transportation and storage of raw materials, requirements concerning straw quality, manufacturing process, layout of a "Stramit" plant, cost factors, properties and applications of the finished product, and marketing problems. The plant established in Thailand uses rice straw exceeding a certain length as a raw material. The manufacturing process is simple and includes pressing of the straw into a continuous slab without the addition of a binder, covering the faces of the heated slab with paper liners, and cutting to size. The panels having a thickness of ca. 50 mm show satisfactory strength properties, good heat and sound insulation values, and high fire resistance.

413. Kalnin, I.
A new method of manufacturing thermal insulation materials.
Kholodiln. Tekhn. no. 6: 57-8 (1958). (Russ.)

A process for the manufacture of thermal insulation panels and [illegible] articles from porous materials, such as wood bark, chopped straw, and reed is briefly described. UF resin is used as the bonding adhesive.

414. Khomenko, Z.S., Otlivanchik, A.N., Korchagina, I.A., and Makarova, M.M.
Hardboards from straw.
Stroit. Materialy no.7: 14-15 (1961). (Russ.)

Straw is cooked at 100°C with a 0.2-1% sodium hydroxide solution (liquor-to-straw ratio of 8-10:1), then is chopped, and beaten to 13-16 °SR in a hammer mill. The processed straw is added in amounts of 30-50% to hardboard fibrous stock or in amounts of 10-30% to insulation board stock. The boards are formed in the usual way.

415. Maciver, W.J.
Insulating board from waste straw.
Pulp Paper Mag. Can. 53, no. 7: 101-5 (June, 1952).

The Canadian Bodite process for manufacturing insulating board from soaked, shredded, and chemically treated straw is described. The process is continuous, excepting the pressing stage; it requires mechanical equipment of new design. Bodite board is only one-third as heavy as wood pulp board, but shows good fire resistance. Nail--holding and screw-holding values are satisfactory, whereas tensile strength is somewhat lower than that of wood pulp boards.

416. Sinclair, G.D., and Sallans, H.R.
New Saskatoon plant produces insulating board from straw and hardboard from wood.
Paper Trade J. 142, no. 50: 48-53 (Dec., 1958); Pulp Paper Mag. Can. 59, no. 12: 106-10 (Dec., 1958); Paper Mill News 81, no. 50: 10, 12, 24-5 (Dec., 1958); Can.Pulp Paper Ind. 12, no. 2:28, 30, 32, 34, 36, 38 (Feb., 1959).

The first mill in Canada to produce insulating board from straw pulp is described. Because of the possibility of a straw shortage during drought years, wood can be used as an alternative raw material.

417. Wisniak, J., Lauterbach, A., and Vergara, P.
The possible use of wheat straw and red mace for the manufacture of acoustical tile.
Tappi 45, no. 9: 226-30A (Sept., 1962).

The possibility of manufacturing insulating board, especially acoustical tile, from wheat straw and red mace (Typha angustifolia Linn.) by mechanochemical pulping has been studied. Runs were made with cooking times of 10 to 60 min., alkali concentrations of 0 to 5% CaO and 0 to 3% NaOH. Some of the cooking variables, the degree of refining of the pulp, and the finishing of the surface were investigated with respect to their influence on the acoustical properties of the boards. The results provide evidence that sound-absorbing properties of the boards are better than those of tiles made from bagasse or pine pulp.

<u>Sorghum</u>

418. Escourrou, R.
Sorghum as a raw material for the manufacture of papermaking and other pulps.
Papeterie 87, no. 11: 1479-82 (Nov., 1965). (Fr.)

The author gives the full text of a patent dealing with the pulping of sorghum (of the "paper sorghum" variety). Sorghum stems are cooked in a rotary digester, first with 0.2-0.8% NaOH for 0.5-1 hr, then with 1.2-2% NaOH at 120°C for 2-3 hr. The resulting pulp, either bleached or unbleached, is preferably blended with wood pulp to give particle boards and various paper grades. According to recent data, the quality of insulating boards is improved by the replacement of spruce fibers by sorghum fibers.

419. Nemrhal, J., and Kuniak, L.
Sweet sorghum as a raw material for the manufacture of fiberboards.
Drevo 16, no. 1: 16-17 (Jan., 1961). (Slovak.)

The utilization of sorghum (Sorghum saccharatum) waste for the manufacture of hardboards was investigated in laboratory experiments. The material was treated with 1% NaOH at room temperature for 4 hours, fiberized in a Bauer refiner to 10 °SR, mixed with a sizing and waterproofing agent, and pressed into boards. An additional heat treatment at 140°C for 4 hours followed. The physical and mechanical properties of the sorghum hardboards were equal or even superior to those of standard hardboards made from sprucewood. The best results were obtained with boards containing a thermosetting resin.

<u>Sunflower husks</u>

(see also abstract no. 292)

420. Mikirtychev, V.A., and Chervyakov, I.A.
Building boards from sunflower husks.
Nauch.-Tekh. Inform. no. 1/2: 10-12 (1960). (Russ.)

Building boards were produced on a laboratory scale from sunflower husks using PF or UF resins as binders in amounts of 10-12% of the waste material. The manufacturing process and the physical properties of the resulting boards are briefly described.

E. TESTING, QUALITY CONTROL, STANDARDS AND MARKETING.

General

421. de Longeaux, M.
Problems of marketing and promotion related to the introduction of panels from agricultural wastes into the markets of the developed countries.
ID/WG.83/3. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 29 p. (Fr.)

The problem of introducing panels from agricultural residues into the market is to overcome the resistance of the consumer to the new products. In general, boards made from wood are considered to be superior to those made from annual plants. Therefore, the production of panels of poor quality and misapplications of the products should be excluded from the very beginning. The paper emphasizes the importance of a comprehensive market study, and enumerates the main measures to be taken in developing countries to promote the utilization of the locally produced panels, such as training of the technical salesmen, broadening of local building codes and government specifications, establishing of demonstration centres, etc.

422. McKenzie, T.A.
Marketing particle board and the feasibility of a proposed mill in Grangeville, Idaho: A two-phase study covering markets and manufacturing.
U.S. Dept. Commerce, Area Redevelopment Admin., Aug., 1965. 62 p. (Available from CFSTI, Springfield, Va. 22151; PB 177 692).

423. Neusser, H.
Standards and quality control for panels made from agricultural wastes.
ID/WG.83/7. UNIDO Expert Working Group Meeting on the Production of Panels from Agricultural Residues, Vienna, 14-18 Dec., 1970. 26 p.

The author emphasizes the importance of an effective production control in the manufacture of panels from wood and agricultural residues. The main properties to be controlled are specified, while considering different types of panel (incl. glued mats and boards from stalks; wood-wool boards and similar light building materials; cement-bonded building materials made from particles; fiberboards; and particle boards), and referring to ISO and various national testing methods and quality standards. Although production control is expensive, it can contribute to the profitability of the plant.

424. Sandermann, W., and Kohler, R.
Studies on mineral-bonded wood products. IV. A rapid test to determine wether an industrial wood is suitable for admixture with cement.
Holzforsch. 18, no. 1/2: 57-9 (April, 1964). (Ger.)

Certain wood extractives, such as tannins, coloring materials, and carbohydrates, inhibit the setting of cement, and it is impossible to make cement-bonded panels of satisfactory strength from woods or other fibrous materials containing a certain amount of these inhibiting substances. In order to determine which raw material could be used satisfactorily, a rapid test method was devised for measuring the heat of hydration of mixtures of wood meal, cement, and water. Those woods which are well suited for admixture with cement gave rise to maximum hydration temperatures of 60°C. Useless woods gave temperatures below 50°C. The measuring device used is described in detail.

425. Segring, S.B.
Distribution problems in the wallboard industry; technical--economical considerations.
Svensk Papperstid. 57, no. 23: 885-98 (Dec., 1954). (Swed.)

A committee appointed by the Scanboard organization has carefully studied shipping problems of the wallboard industry and investigated various possibilities for reducing present high costs. Various types of bales were tested. Standardized crate types offer many advantages. The lowest total freight costs are obtained, however, when the boards are shipped in loose bulk form. Many illustrations are included.

Arecanut husks

426. Narayanamurti, D.
Fibre boards from Indian timbers.
Indian Forester 86, no. 1: 5-15 (Jan., 1960).

Both hardboards and insulation boards with satisfactory properties can be produced from indigenous Indian raw materials, incl. tapioca stems, areca-nut husk, bagasse, bamboo, and the wood and bark of various conifers and hardwoods. The properties of the boards obtained either by the Asplund process or by a mild chemical cook (0.5-1.0% sodium hydroxide at 100°C) are tabulated.

427. Narayanamurti, D., Gupta, R.C., and Singh, J.
Measurements of swelling pressure in wood-particle boards.
Holz Roh- u. Werkstoff 20, no. 3: 89-90 (March, 1962). (Ger.)

Thermodyne boards and thermally plastified particle boards made from two tropical woods, arecanut husk, and bamboo (Bambusa polymorpha) were examined with a Cope tensiorheometer. The results obtained indicated that the measurement of the swelling pressure by this method gives a good criterion for evaluating the swelling resistance and dimensional stability of wood-based products.

Bagasse

(see also abstract no. 426)

428. Maku, T., Sasaki, H., Ishihara, J., Kimoto, K., and Kamo, H.
On some properties of composite panels.
Wood Res. (Kyoto) no. 44: 21-52 (July, 1968). (Jap.)

Composite building panels were evaluated for thermal conductivity, warping as a function of moisture content, bending strength, modulus of elasticity, flame resistance. Materials used as laminate plies included decorative veneer, plywood, wood fiber insulation board, wood particle board, bagasse particle board, paper honeycomb, and various mineral boards. Results are shown in tables and graphs.

429. Sun, K.-Y., and Wei, Y.-Ch.
Preliminary studies of perforated "sugar-cane fiberboard" sound absorbers.
Acta Phys. Sin. 19, no. 3: 151-9 (March, 1963). (Chin.)

The sound-absorbing and vibration-dampening properties of insulation board made from sugar-cane bagasse were investigated. Solid boards exhibited mechanical vibration determined by boundary conditions, as well as resonance absorption in thin panels backed by an air space. When the board was perforated, resonance peaks became less prominent. The overall sound absorption was higher than for other perforated insulating panels.

430. Technical Association of the Pulp and Paper Industry
Determination of useful fiber in bagasse.
Tappi Useful Method no. 3 (formerly Routine Control Method RC 334).

This method describes a procedure for estimating the percentage of fiber, pith, and soluble matter in bagasse. The apparatus needed includes a standard disintegrator, sieves, rubber tubing, a drying oven, and balance.

Bamboo

(see also abstract no. 426 ; 427)

431. Aung, T., and Kha, M.M.
Thermal properties of insulating boards made from Burmese bamboo.
Union of Burma J. Science Technol. 2, no. 1: 215-19 (April, 1969).

432. Narayanamurti, D., Prasad, B.N., and George, J.
Protection of chipboards from fungi and termites.
Norsk Skogind. 15, no. 9: 375-6 (Sept., 1961).

Particle boards made from bamboo (Dendrocalamus strictus) were treated with pentachlorophenol or Xylamon and exposed to attack by fungi and by termites, as well as to soil burial. The results obtained in laboratory and graveyard tests are reported. In laboratory culture tests, 5% penta gave the best protection, whereas 2% Xylamon was ineffective. In graveyard tests, all treated boards remained sound for 170-329 days, and those treated with 2 or 5% Xylamon for 482-630 days. Boards containing 1-2 or 5% penta resisted termite attack in South Africa for 2 years.

Cassava

(see abstract no. 426)

Corncobs

433. Samek, J.
Review of the most important properties of new wood products.
Drevo 15, no. 5: 143-5 (May, 1960). (Czech.)

The mechanical and physical properties of wood products newly introduced on the Czechoslovakian market are tabulated. In some of the products, agricultural residues (straw, corncobs) are used: Likus is a board made of a mixture of wood waste and agricultural residues; Solomit is a reinforced board from rape straw.

Flax and hemp

434. Flemming, H.
Extreme material combinations exemplified by glass-fiber-reinforced flax shive boards.
Holztechnol. 7, no. 3: 185-9 (Aug., 1966). (Ger.)

Following a review of material combinations, particularly glass-fiber combinations, used as construction materials, data are presented on the properties of a glass fiber/flax shive board laminate. The laminate is of particular use in the construction of house trailers, freight trailers, etc.

435. Frackowiak, A., and Koslowski, R.
Properties of flaxboard.
Institute of Bast Fiber Industry (Lodz), Report no. 11 (1963). (Pol.)

436. Institute of Wood Technology.
Possible uses of flaxboards in the furniture industry.
Final Report no. 04 30 01 h/AE 3-101/FK, Institute of Wood Technology, Dresden, February, 1964. 80 p. (Ger.)

This is an extensive study of the physical properties of flaxboards, their workability, and utilization in the furniture industry. In particular, the following items have been investigated: hygroscopicity of the boards at different humidities, water absorption and thickness swelling after submersion in water, surface quality and coating, glued joints and loose joints, and stability of the panels. Recommendations are given concerning the optimum utilization of flaxboard.

437. Lawniczak, M., and Nowak, K.
The influence of hydrophobing impregnating agents on moisture--caused dimensional changes in wood-particle and flax-chaff boards.
Holz Roh- u.Werkstoff 20, no. 2: 68-72 (Feb., 1962). (Ger.)

Wood-particle and flax-chaff boards were treated with two paraffin-based commercial waterproofing agents in amounts of 0.5%. By this means, the 24-hour thickness swelling in water could be reduced by ca. 56% in particle board and 85% in chaff board. After 140 days of storage in moist air, waterproofed flax-chaff boards had swollen 60% less than untreated boards.

438. Lawniczak, M., Nowak, K., and Raczkowski, J.
Properties and uses of flax and hemp waste boards.
Drevo 17, no. 1: 5-8 (Jan., 1962). (Czech)

Chaff or waste from the processing of flax and hemp constitutes up to 50% of the weight of these materials. In Poland, a large fraction of the chaff is utilized for the manufacture of particle boards by the Linex-Verkor process. Results of tests carried out to determine the physical and mechanical properties of commercial products of various densities are reported. The swelling and water vapor sorption of chaff boards were lower than those of three-layer wood-particle boards. The mechanical properties (bending and tensile strengths, hardness, and nail resistance) were comparable to those of wood--particle boards of the same density.

439. Lawniczak, M., Nowak, K., and Zielinski, S.
Mechanical and technological properties of flax board.
Holz Roh- u. Werkstoff 19, no. 7: 232-9 (June, 1961). (Ger.)

On the whole, flaxboards have mechanical and technological properties equal to those of wood-particle boards of the same density. However, since no water-repellent agents are used in the manufacture of flaxboard at present, the water absorption and linear thickness swelling of boards having a density of 0.60 and 0.65 g/cu.cm are somewhat higher than those of wood-particle board. The most important use of flaxboard is in the manufacture of furniture. Because of particularly high heat insulation capacities and sound absorptivity, flaxboards are increasingly used in the construction industry.

440. Lawniczak, M., and Raczkowski, J.
The effect of gamma radiation on lignocellulose particle/urea-formaldehyde binder compositions.
Holztechnol. 5, Special Issue: 39-42 (1964). (Ger.)

Studies involving the subjection of flax-particle board to Co^{60} γ-radiation showed that board static bending strength, impact bending strength, and hardness decreased with increasing radiation dose. Board hygroscopicity and thickness swelling were not affected significantly by the radiation. The effects of γ-radiation on flax-particle board were similar to those of γ-radiation on wood-particle board and wood.

441. Nowak, K., and Paprzycki, O.
Testing of glue lines in bonding flaxboard with wood and other wood-based materials.
Przemysl Drzewny no. 8 (1961). (Pol.)

In Poland, flaxboard is commonly used in furniture manufacturing, and as flooring underlayment and roof-sheathing material. For evaluating the adhesive bonding characteristics of flaxboard, shearing strength and water-resistance of glued joints including the following combinations were determined: flaxboard/flaxboard; flaxboard/pinewood; flaxboard/hard fiberboard. Protein glues, urea-formaldehyde resin, or phenol-formaldhyde resin were used as binder. The samples were tested untreated, after exposure to high air humidity for 30 days, and/or after submersion in water for 24 hours. By far the lowest strength was obtained with the flaxboard/hardboard combination while the other samples did not show much difference. Phenol-formaldehyde resin gave bounds of particularly high water resistance followed by urea-formaldehyde resin, and casein glue.

442. Nowak, K., Paprzycki, O. and Czechowski, W.
Effect of density on some physical and mechnical properties of flaxboard.
Przemysl Wlokienniczy 1962, No. 5. (Pol.)

443. Nozynski, W.
Testing of flaxboard roofing.
Institute of Building Techniques (Poland) no. 10 (1962).

Rape straw

(see also abstract no. 433)

444. Büttner, M.
Danger of decay of materials of wood and annual plants by fungi.
Holztechnol. 6, no. 2: 123-7 (May, 1965). Ger.

Studies of the decay of rape straw and the European hardwood fiberboards, and of various pinewood-particle boards by fungi showed that, in general, all of the materials were more or less susceptible to fungi attack. The importance of the development of effective preservative treatments for particle boards and fiberboards is emphasized.

Appendix

LIST OF STANDARDS RELATED TO FIBERBOARD AND PARTICLE BOARD

Standard		Title
CANADA		
CGSB	11-GP-0	Methods of sampling and testing fibreboard
CGSB	11-GP-1	Board: particle, building construction
CGSB	11-GP-2	Fibreboard: insulating
CGSB	11-GP-3	Fibreboard: hard-pressed
CZECHOSLOVAKIA		
CSN	49 0133	Board of agglomerated wood and similar materials
CSN	49 0141	Testing of board of agglomerated wood and similar materials
CSN	49 0142	Thickness, volume and square weight
CSN	49 0143	Humidity
CSN	49 0144	Water absorption and swelling
CSN	49 0145	Linear expansibility
CSN	49 0150	Tensile strength parallel to the board level
CSN	49 0151	Tensile strength perpendicular to the board level
CSN	49 0152	Bending strength
CSN	49 0154	Impact strength (impact test)
CSN	49 0155	Wood screw-holding test
CSN	49 0156	Nail-holding test
CSN	49 2601	Board of agglomerated wood and similar materials: basic and general specifications
CSN	49 2612	Fiberboard
CSN	49 2614	Wood particle board
CSN	49 2615	Board of agglomerated wood - sawdust board
CSN	49 2616	Board of agglomerated wood - "Lignat" board
CSN	49 2620	Fiber wallboard "Likus"
CSN	49 2801	Wood particles and similar materials for industrial purposes: basic and general specifications
FRANCE		
FN B	51-100	Fibreboard: definitions, classification
FN B	51-101	Test: samples and test specimens

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PN B 51-102	Test: moisture content
PN B 51-103	Test: density
PN B 51-104	Test: water absorption and changes in dimensions on immersion
PN B 51-105	Test: tensile strength parallel to surface
PN B 51-106	Test: tensile strength perpendicular to surface
PN B 51-107	Test: bending strength
PN B 51-108	Test: compression strength
PN B 51-109	Test: "Monnin" hardness
PN B 51-110	Test: "Brinell" hardness
PN B 51-200	Particle board: definitions, classification
PN B 51-201	Test: samples and test specimens - reporting of results
PN B 51-202	Test: moisture content
PN B 51-203	Test: density
PN B 51-204	Test: water absorption and changes in dimensions on immersion
PN B 51-205	Test: changes in weight and dimensions with variations in relative humidity
PN B 51-206	Test: tensile strength parallel to surface
PN B 51-207	Test: tensile strength perpendicular to surface
PN B 51-208	Test: bending strength
PN B 51-209	Test: "Monnin" hardness
PN B 51-210	Test: deformation under concentrated load
PN B 51-211	Test: screw withdrawal resistance

GERMAN DEM. REP.

TGL 3139	Testing of fibreboard and particle board: determination of thermal conductivity
TGL 5772	Testing of fibreboard and particle board: determination of behavior in fire
TGL 6487	Wood fibre and wood particle board products: timber residue suitable for conversion
TGL 7796	Particle board: dimensions
TGL 8767	Testing of fibreboard and particle board: determination of internal bond strength
TGL 11367	Testing of fibreboard and particle board
TGL 11368	Testing of fibreboard and particle board: determination of moisture content
TGL 11369	Testing of particle board: determination of thickness, squareness, weight per unit area and density
TGL 11371	Testing of particle board: bending strength

TGL	11372	Testing of fibreboard: determination of thickness, squareness, weight per unit area and density
TGL	11373	Testing of fibreboard: determination of swelling
TGL	11374	Testing of fibreboard: bending strength
TGL	11602	Fibreboard: dimensions
TGL	11603	Compressed wood fibreboard: technical specifications

GERMANY, FED. REP. OF

DIN	52350	Testing of fibreboard: sampling, thickness measurement, determination of weight per unit area and density
DIN	52351	Testing of fibreboard: determination of moisture content, water absorption and swelling
DIN	52352	Testing of fibreboard: bending test
DIN	52360	Testing of particle board: general; sampling; evaluation
DIN	52361	Testing of particle board: determination of size, density and moisture content
DIN	52362	Testing of particle board: determination of bending strength
DIN	52364	Testing of particle board: determination of thickness swelling
DIN	52365	Testing of particle board: determination of tensile strength perpendicular to the board
DIN	68750	Fibreboard: noncompressed and compressed board; quality requirements
DIN	68751	Fibreboard with decorative plastic overlays: quality requirements, testing
DIN	68752	Fibreboard: bituminous, quality requirements
DIN	68761 Part 1	Particle board, density 450 to 750 kg/m^3: terminology, quality requirements and tests
DIN	68761 Part 2	Particle board, density below 450 kg/m^3 (low-density particle board): quality requirements and testing

INDIA

IS	1658	Fiber hardboard
IS	2380	Methods of test for wood particle board and board from other lignocellulosic materials

ITALY

UNI	2088	Compressed fibreboard (hardboard): thickness and tolerances
UNI	2089	Noncompressed fibreboard (insulation board): thickness and tolerances

UNI	3741	Testing of fibreboard: types of board
UNI	3742	Testing of fibreboard: general, conditioning, determination of thickness
UNI	3743	Testing of fibreboard: determination of water content
UNI	3744	Testing of fibreboard: determination of weight, density
UNI	3745	Testing of fibreboard: bending strength (statical test)
UNI	3746	Testing of fibreboard: determination of the modulus of elasticity in bending
UNI	3747	Testing of fibreboard: tensile strength
UNI	3748	Testing of fibreboard: compressive strength
UNI	3749	Testing of fibreboard: behavior in water on immersion
UNI	4369	Testing of fibreboard: determination of water absorption and swelling due to humid air influence
UNI	4370	Testing of fibreboard: determination of electric resistance
UNI	4371	Testing of fibreboard: determination of dielectric resistance (arcing)
UNI	4866/67	Particle board: dimensions, tolerances, classification
UNI	4868	Particle board: sampling and conditioning
UNI	4869	Particle board: determination of thickness
UNI	4870	Particle board: apparent specific gravity
UNI	4871/72	Particle board: determination of moisture content (water absorption and swelling)
UNI	5062P	Fibreboard: types and tolerances
UNI	5063P	Testing of wood fibreboard: sampling and conditioning
UNI	5064P	Testing of fibreboard: determination of dimensions of samples
UNI	5065P	Testing of fibreboard: determination of specific weight
UNI	5066P	Testing of wood fibreboard: determination of moisture content
UNI	5067P	Testing of fibreboard: bending strength
UNI	5068P	Testing of wood fibreboard: water absorption and swelling

JAPAN

JIS A 5905	Insulation board
JIS A 5906	Semi-hardboard
JIS A 5907	Hardboard
JIS A 5908	Particle board

POLAND

PN-61/D-02001	Particle board (including flax board): classification
PN-60/B-22120	Wood fibreboard
PN-63/D-22121	Noncompressed perforated fibreboard
PN-63/D-22122	Compressed perforated fibreboard
BN-62/7113-01	Compressed fibreboard, plainfinished
BN-64/7113-03	Noncompressed fibreboard covered with groundwood
RN-61/MliPD-04031	Three-layer particle board
RN-60/MPL-3243	Flaxboard

ROMANIA

STAS 5855	Particle board: static bending test
STAS 5884	Particle board: determination of water absorption, hygroscopicity, swelling
STAS 6159	Particle board of wood and other lignocellulosic materials: screw and nails withdrawal test
STAS 6292	Particle board: determination of tensile strength perpendicular to the board
STAS 6438	Three-layer particle board

SPAIN

UNE 41 125	Fibreboard: definitions and classification
UNE 41 127	Fibreboard: sampling, sample preparation, determination of thickness
UNE 41 128	Fibreboard: determination of moisture content
UNE 41 129	Fibreboard: determination of water absorption and linear expansion
UNE 41 130	Fibreboard: determination of density
UNE 41 131	Fibreboard: determination of hardness
UNE 41 132	Fibreboard: compression test

SWEDEN

SIS 235101	Fiber building board: definitions and types
SIS 235102	Fiber building board: determination of dimensions
SIS 235103	Fiber building board: determination of density
SIS 235104	Fiber building board: determination of moisture ratio
SIS 235105	Fiber building board: determination of water absorption
SIS 235106	Fiber building board: determination of bending strength
SIS 531610	Insulation board: dimensions

SIS	[illegible]	Wall boards: dimensions

UNITED KINGDOM

BS	114[illegible]	Fiber building board
BS	181[illegible]	Methods of test for wood chipboard and other particle boards
BS	260[illegible]	Resin bonded wood chipboard

UNITED STATES

ASTM	D [illegible]	Methods of test for wood-based fiber and particle panel materials
CS	4[illegible]-49	Structural fiber insulating board
CS	[illegible]	Homogeneous fiber wallboard
CS	[illegible]	Prefinished hardboard wall panels
CS	236-6[illegible]	Mat-formed wood particle board (interior use)
CS	251-6[illegible]	Hardboard

U.S.S.R.

GOST	4598	Fiberboard
GOST	8904	Compressed fiberboard (hardboard) with protective painting
GOST	9620	Composite fiberboard on Portland cement basis

YUGOSLAVIA

JUS	D.A1.080	Testing of fibreboard: sampling
JUS	D.A1.081	Testing of fibreboard: measuring of defects
JUS	D.A1.082	Testing of fibreboard: thickness measuring
JUS	D.A1.083	Testing of fibreboard: moisture content
JUS	D.A1.084	Testing of fibreboard: determination of water absorption and thickness swelling
JUS	D.A1.085	Testing of fibreboard: weight per unit area and specific density
JUS	D.A1.086	Testing of fibreboard: ultimate tensile strength
JUS	D.A1.087	Testing of fibreboard: bending strength
JUS	D.A1.100	Testing of particle board: sampling
JUS	D.A1.102	Testing of particle board: thickness measuring
JUS	D.A1.103	Testing of particle board: humidity
JUS	D.A1.104	Testing of particle board: determination of water absorption and swelling
JUS	D.A1.105	Testing of particle board: weight per unit area and specific density
JUS	D.C5.022	Fibreboard
JUS	D.C5.030	Particle board

SUBJECT INDEX

Note: The numbers refer to the numbered entries in the bibliography and not to the page numbers.

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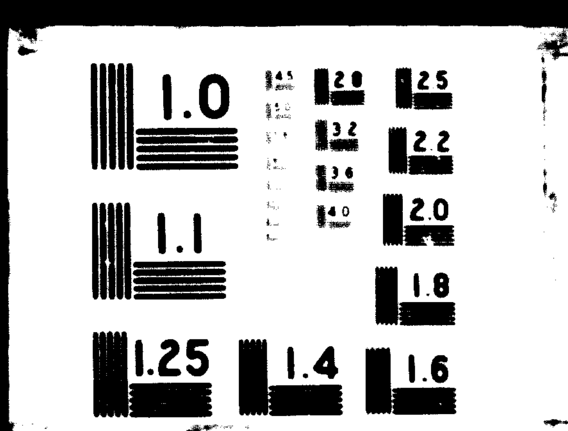

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