OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards even though the best possible copy was used for preparing the master fiche

07695

Distr.
LIMITED

ID/WG.248/12
17 October 1977

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Workshop on Adhesives used in the
Wood Processing Industries

Vienna, Austria, 31 October - 4 November 1977

EQUIPMENT FOR PREPARING READY-TO-USE ADHESIVES[1/]

by

S. Senn*

* Fahrni Institut AG, Zürich

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.77-7450

CONTENTS

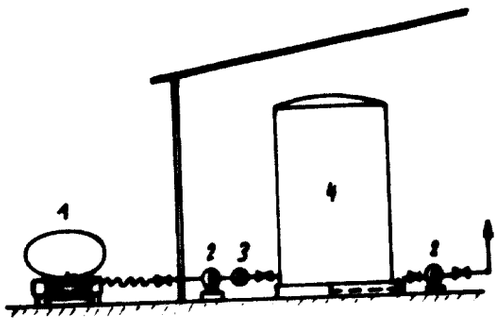
Introduction

In the particleboard or plywood industry the section between the raw glue tank and the glue spreader is quite often called the "glue kitchen". Even when translated into various languages, the smelly, dampy, dirty connotation of the term remains. We assume it is because raw materials are blended there in much the same way as the medieval alchemists mixed their ingredients that plant personnel has come to give the section this name. We all know that the glue deck is hardly ever an inviting place, either for the operator or for visitors. Even the fact that considerable differences are sometimes found between the theoretical glue consumption - based on wood flow and resin solids applied - and the inventory reading of the storage tanks - does not make a sufficiently serious impression on the staff to induce them to give more consideration to the glue mixing equipment. In almost every plant, the glue deck seems to have been built last - when the original project cost evaluation, as usual, showed an unbelievably simplified figure. There is nothing to say against a simple glue deck, but the need to solve pollution problems, assure uniform quality and to provide the operator with decent working surroundings has induced plant designers and project engineers to work out more sophisticated arrangements.

1. Storage of raw glue

In our industry, any kind of raw glue is received either in a solid, powdered state or in liquid form. In Europe or the U.S., powdered glue is rather seldom. The liquid glue arrives in large road tankers containing approximately 20 tons and is transferred to the storage tanks by means of large transfer pumps. The tank should be connected to a positive displacement pump suitable for handling the glue in question and rated to give a 50 minute off-load time. The pump should be protected by a pressure relief valve and have filters on its infeed side. It is advisable to have enough storage capacity to assure 3 weeks' production with full tanks and not to mix a fresh batch of glue with an old one. It happens everywhere that once in a while the glue freezes in the tanks and the question of responsibility becomes evident if glues from different suppliers have been mixed in the same tank. Steel tanks with and without an inner coating

(e.g. epoxy) are common, but horizontal, round concrete tanks with a bitumen or epoxy coating are also frequently used. Large steel tanks should be placed horizontally. Vertical steel tanks have sometimes caused problems. Since at least once in a plant's history a glue freeze-up will occur, one should have a big service access into the tank for the pneumatic hammer etc. As long as the glue is still more or less liquid but cannot be pumped anymore, high pressure water spray guns such as used, for example, by the fire brigade will be extremely helpful in extracting the mess from the tank. Picture No. 1 shows an appropriate set-up for liquid glue storage equipment.



1 road tanker
2 pump
3 flow-meter
4 glue tank

Fig. 1
Liquid glue storage equipment

Most glue suppliers' leaflets mention that proper insulation of the tanks should be provided in hot countries. In Brazil, Mexico, Greece, etc. We have had good experience with round, vertical concrete tanks with a capacity of fifty tons. The concrete shell has been insulated with glass fiber wool or styrene and an outer layer of brick. Of course, one feels even more safer if in such countries the tanks are protected against direct exposure to the sun by a roof. In some cases we have not even coated the inner concrete surface and yet never noted any detrimental effect.

If a plant has to work with powdered glue, the glue storage equipment is restricted to a simple storage hall. It must be kept in mind, however, that phenolic, wattle and many other organic adhesives burn easily and require proper protection. For small particleboard plants up to a capacity of 50 tons per day, batches of approximately 1 ton of glue mix are quite common. Aluminium, steel or polyester tanks are used for most types of glue. The bags of powder, generally containing 50 kg, are emptied into the tank, which preferably should still have a small amount of old glue from the previous batch remaining in it. The correct amount of water is added by means of a flow meter, then urea (when UF binder is to be prepared) up to 6 per cent based on solid UF glue, and the batch is then agitated at a speed of 100 to 300 rpm depending on the type of agitator. The UF binder is diluted until it contains between 55 and 65 per cent resin solids.

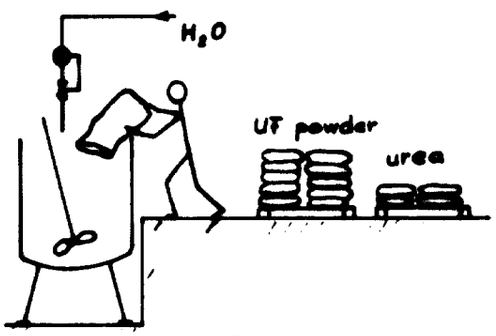


Fig. 2
Batch glue mixers

For PF and wattle glue it is recommended to make a paste. Consequently, a rather rigid stirring arrangement is used to agitate the initially very viscous binder. PF binder is generally diluted to about 50 per cent resin solids.

In the plywood industry, raw glue is stored in the same manner. When powdered glue is used, the ready-to-use glue is commonly prepared in one operation, as discussed in Section 3.

2. Preparation and storage of the usual ingredients

For UF, PF, wattle and other natural glues, the following ingredients are of importance:

starch
wax emulsion
hardener
ammonia
water
fungicides, dye etc.

2.1. Starch

In most of the smaller plants, starch is added mannually in solid form to the adhesive blending equipment described in section 3 and does not need special equipment for its preparation. In highly automated plants, however, the starch for the face glue is pre-mixed with water in order to obtain approximately a 33 per cent solution. The size of the batch is always calculated in such a way that the contents of one or several bags of starch are filled into the stirring tank without having to open the bags and weigh the compound. In such a case it is preferable to keep the starch solution constantly circulating in a ring circuit in order to avoid segregation in dead corners and valves.

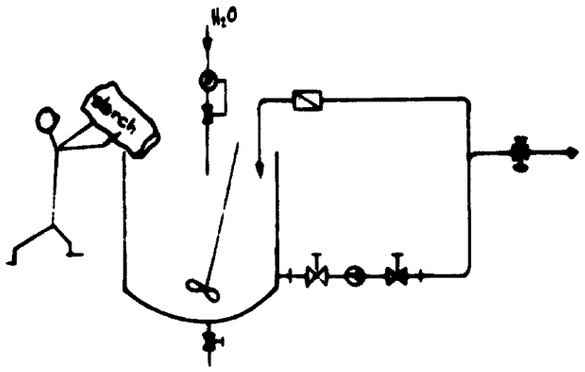


Fig. 3
Circuit line for starch mixers

2.2. Wax emulsion

The size of the wax emulsion tanks is usually designed in accordance with carload size. In Europe road tankers often have a capacity of 15 t of emulsion. Large plants have an emulsion storage capacity of

up to 40,000 litres. In many countries, however, the emulsion is delivered in barrels and a small pump is used for transfer to the buffer.

2.3. Hardener

Hardeners for UF, PF and wattle glues are usually delivered to the plant in solid form and then dissolved or else incorporated directly into the glue mix. Ammonium chloride or ammonium sulphate, hexa, carbonates and para-formaldehyde are commonly used for the usual adhesives in our industry. Ten to twenty per cent ammonium chloride solutions are very common for UF glue; sulphate solutions of 35 per cent are also possible. The hardeners for the other glues and their dilutability are indicated by the supplier. For the particleboard industry, buffer solutions of ammonia and hardener are strongly recommended. Such a solution can be used in every plant where the ratio of ammonia to hardener solids is equal or similar for both the face and core glue. In such a case, the ammonium chloride or sulphate is added to a dissolving tank and the water and ammonia are added with a flow meter or other dosing device. To avoid penetrating ammonia fumes in this area, it is useful to install a simple suction hood. According to the literature the stirring tank should consist of stainless steel. So far we have also had good experience with epoxy-coated regular steel tanks.

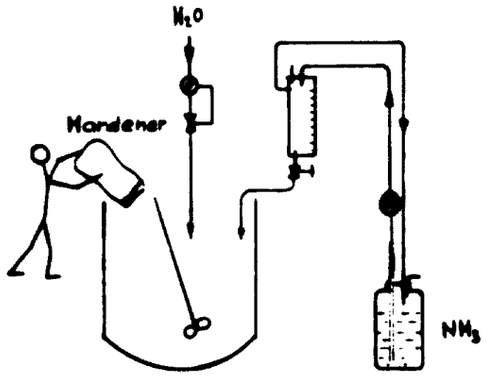


Fig. 4
Preparing the right ratio of ammonia and hardener

2.4. **Ammonia**

In industrialised countries ammonia is stored in separate tanks. Ordinary steel tanks with or without coating are commonly used. It should be remembered that copper or copper alloys should never be used in connection with ammonia.

Ammonia is also quite commonly supplied to customers in 50 kg plastic containers.

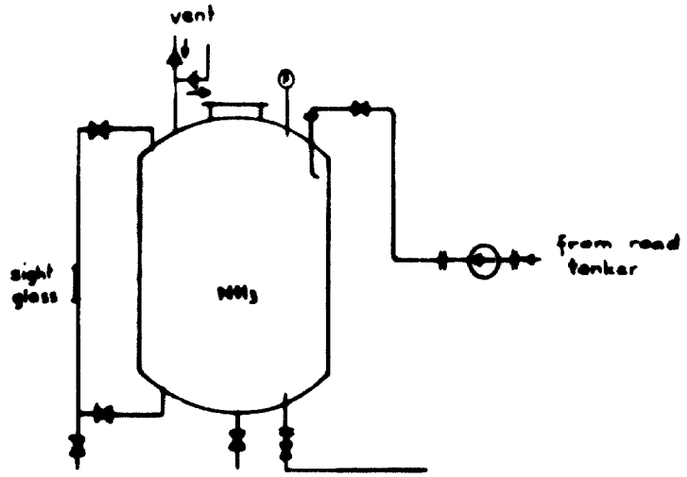


Fig. 5
Amonia storage tank with ventsystem

At first sight it may appear sensible to design the ammonia tank without an exhaust pipe in order to prevent the smell from escaping. It should be kept in mind, however, that it is really impossible to pump any kind of liquid into the tank, if a vent pipe is not built in the buffer, because of the vacuum pressure generated in the storage tank after the pump has been started. Therefore a self-adjusted valve should be installed to ensure air access and escape whenever the level in the tank changes. The transfer pump, however, should be of cast iron or plastic. PVC tubes proved to be appropriate for ammonia and hardener solution.

2.5. Water

No provisions for water storage have to be made. One should keep in mind that very hard water is detrimental to the quality of the glue. If the emulsion is prepared in the plant itself, the water has to be processed via a ion exchanger.

2.6. Fungicides, dye etc.

Storage and dilution instructions are given by the individual suppliers.

3. Adhesive blending equipment

3.1. Metering equipment

3.1.1 Bucket metering

In very simple plants the bucket system is still in use. The operator fills a mixing tank with glue up to a set level. This is either done by means of a transfer pump, and the powdered glue is added manually. The relatively small amounts of ingredients have been weighed in buckets beforehand. The hardener and other compounds are not even dissolved in water. As soon as the glue is in the tank, the operator turns on the agitator and pours the content of the buckets into the mixing tank one after another. This sytem allows easy adaption to changes in formula. It might be said that the formula changes occasionally without being noticed, depending on the operator's state of mind or degree of experience. The mixing time required to obtain a homogenous glue mix (state of equilibrium) might be somewhat long, and this can affect the accuracy of flow meter measurement of the glue mix because of the emulsified air in the fluid. Consideration will be given to this subject later on. Even small plants have one or two glue deck operators sometimes working under high stress, especially if glue mixes for both core and face material have to be prepared within a period of 30 minutes. The smell of ammonia is very penetrating and the entire glue deck is somewhat slippery.

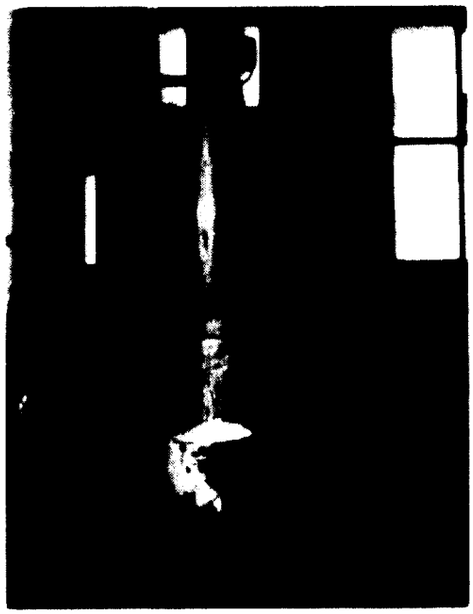


Fig. 6
Bucket metering system

However, if low-cost manpower is available and the operators are very reliable, the investment and maintenance expenditures for this section of the plant are outstanding low. Plywood plants have had good experience with the metering method because of their low hourly glue requirements. Many plywood plants employ this system, especially if they desist from the use of powdered phenolic or wattle glue and use horisontal mixers where the preparation of the paste can be observed rather easily.

3.1.2. Metering with dosing tubes

This system consists basically of a number of transparent sealed acrylic tubes. The level of the components in each tube can be varied by the positioning magnetic switches. This means that a plant can easily adapt to varying glue formulae. To our knowledge some plants have had such equipment manufactured locally or in their own workshops. As the largest tube is for metering the glue, plants sometimes avoid this and dose the glue into the tank with a flow meter or just up to a certain mark on the tank. The relatively small amounts of the other liquid ingredients are added very accurately

by means of small dosing tubes. As magnetic switches, occasionally tend to fail, it is recommended to use flow pipes.

Fig. 7
Gluestorage system with dosing services

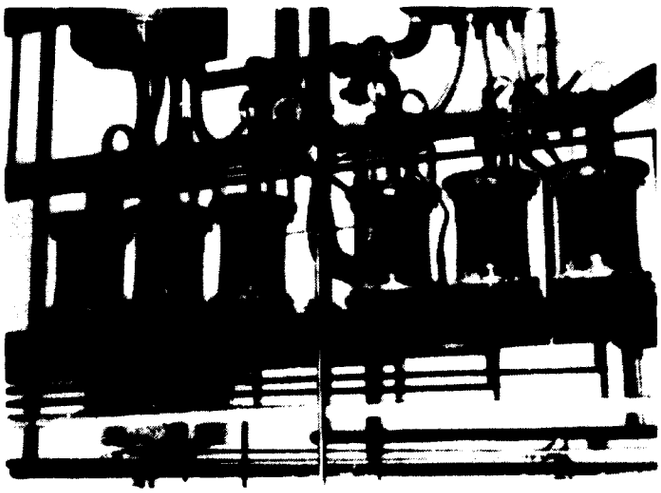


Fig. 8
Dosing tubes

The paraffin emulsion tends to foam when it enters the tube, and accurate dosing becomes somewhat problematic. Starch mixtures for face glue frequently separate in the tube and sometimes clog the drain valve. Furthermore, the tube for the emulsion loses its transparency shortly after start-up, and visual control of the flow is not possible. In case of substantial changes in the glue mix, or rather when production increase gradually the individual tubes or the complete system become a bottleneck. For large plants, the system requires space and a considerable building height, because it operates with the aid of gravity. Relatively strong stirring

of the mix is required. Cleaning has to be done manually in order to avoid contamination of the glue and emulsion pipes. Maintenance is almost negligible and a minimum of manpower is involved if the system is automatic.

3.1.3 Scale metering

In plywood and particleboard plants one can sometimes find a stirring unit with a tank mounted on a scale. Solid or fluid components can be filled into the tank manually with an acceptable degree of accuracy. In large modern plants limit switches interrupt the flow of fluid at a preselected scale. The use of punched cards facilitates changes in the glue formula. This is no doubt a very good solution for glue metering. However, the tolerance of a scale does not allow metering of large and very small amounts of material on the same scale. Therefore, either a two-range scale is used or else the main portion of the glue is metered into the tank by a flow meter or a level indicator. Furthermore, the permanent flow of the liquid still in the pipe between exit and valve renders difficult in the beginning to obtain the accurate glue mix desired. Less maintenance is required with such installations, except that many scales work on an electronic basis and in most plants mechanical maintenance is done more efficiently. Investment costs for automatic scale metering installations are high.

3.1.4. Metering with flow meters

Each component is metered into a mixing tank by means of a flow meter. Each of these is equipped with a dial; the flow of fluid is interrupted electrically when the preset volume of liquid has passed through.

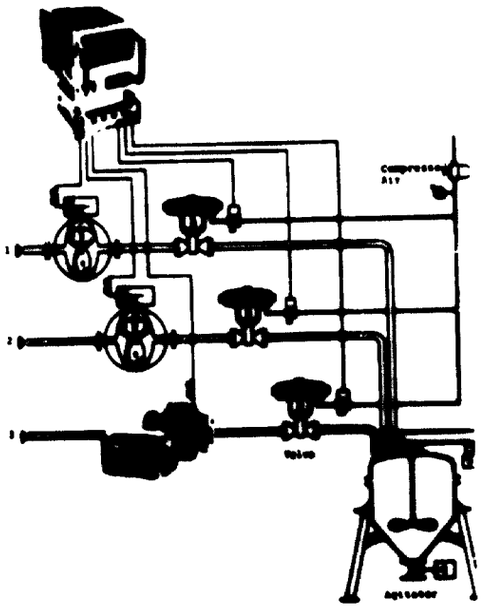


Fig. 9
Flow metering system

The accuracy of reasonably priced flow meters was not convincing for the board industry. Furthermore, if many ingredients have to be dosed, the investment costs are higher than for a system based for example on dosing tubes, and more maintenance is involved. Stirring tanks have to be used for a well balanced glue mix.

3.1.5 Metering with dosing pumps

Proportioning pumps for metering glue and the usual ingredients have been used in the board industry for a long time. Complete engineered units, however, have appeared on the market only recently. For accurate functioning of the pumps, the daily storage containers for each component must not necessarily be placed above the pump unit. These containers are equipped with min./max. sound or float valves which control the supplier pumps. The starch solution is conveniently pumped to the suction side of the dosing pump by means of an independent small pump in a ring circuit. The quantity of fluid conveyed can be varied by changing the length of the stroke

and/or frequency. It should be noted that such a pump is a conveying and measuring device all in one. Units with speed transmitter and indicator are suitable for supplying ready-to-use glue mix directly to the blender, as is shown in Fig. 16. In general, however, the dosed components are conveyed to conventional mixing tanks as shown in Fig. 10.

Changes in glue formula are achieved within a minute by changing the stroke of the appropriate pump. Installations with a speed-controlling device are easily adaptable to a varying demand for glue. The proportioning pump system allows very accurate adjustment to binder requirements prior to shutdown. Glue drainage is avoidable.

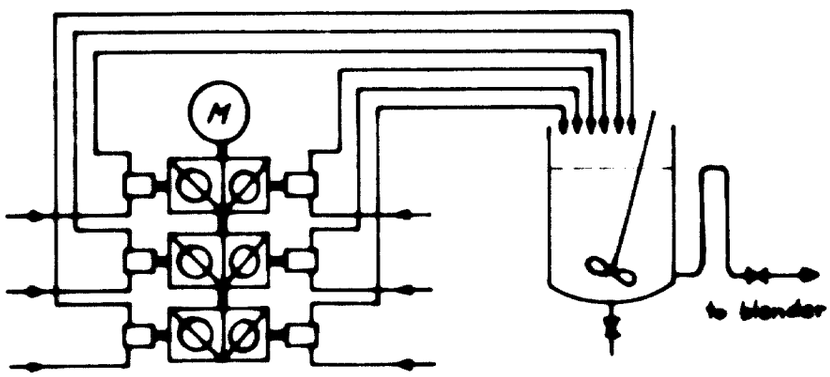


Fig. 10
Dosing pump system

Fig. 11

The dosed components can be conveyed into a conventional mixing tank, but the set-up is ideal for the use of a static mixer for a well balanced glue mix.

Pump valves, packings and sometimes even pump heads need a certain degree of maintenance, the overall annual costs of which are definitely higher than for the dosing tube equipment. The advantage, however, is that this maintenance is purely mechanical and is, therefore, likely to be done more efficiently than hydraulic or electric maintenance. However, the investment costs for such a dosing system are high when a high degree of automatic control with respect to safety and cleaning is included.

3.2. Mix balancing equipment

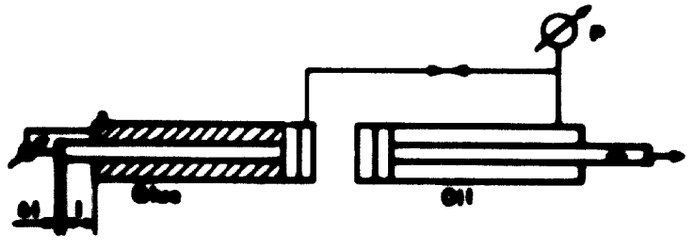
3.2.1 Stirring tanks

All metering installations such as described in chapter 3.1 can fill the glue and the components into a tank with some kind of stirring device. In older European plants, tanks with a bottom disk are quite common. This disk on the bottom of the tank rotates at 200 to 600 rpm. For better mixing, vertical angle irons or baffles are installed in the blenders. Many plants, of course, use conventional blade stirrers which are mounted on top of the tank. Here too, the number of rpm has been found to be between 200 and 600. In some plywood mills, horizontal mixers with a horizontal shaft and diagonal paddles are still in use. If powdered glue and ingredients are used, this kind of mixer is an inexpensive and reliable piece of equipment.

It seems to be a fact that in practice, the specific weight of a glue mix can vary as a result of the blending operation and equipment, even though the composition of the glue mix remains constant. If the dosing to the glue spreader is done volumetrically, the above-mentioned circumstances are responsible for erratic glue flow readings. Since most board plants blend their glue with the type of equipment just described, this problem will now be considered more closely and its possible effect determined.

3.2.1.1 Influence of the mixing operation on glue mix density

Experience in the laboratory and in plants has shown that air is mainly dispersed into the glue mixture during the blending operation. The quantity of air absorbed can be measured by means of compressibility determination or also with simple density measurements. Compressibility determination can be carried out by means of a test device consisting of two cylinders which are controlled hydraulically. One cylinder is filled with hydraulic oil and the other with the glue mix to be tested. When the cylinder with the glue is under pressure, a certain compressibility of the liquid, generated by changing the volume, can be measured.



$$\beta = -\frac{1}{V} \cdot \left(\frac{\partial V}{\partial p}\right)_T$$

$$\beta = f(p_g)$$

Fig. 12
Compressibility tester

The blank value (correction factor) of the system has, of course, to be determined with water first. However, it is not necessary to carry out compressibility determination in order to identify air in the glue mix. Simple density checks will indicate this. The following graphs show the compressibility of both the face and core glue mixes from a plant in Central Europe. The glue was mixed with a mixing device consisting of a tank with a bottom disk, the mixing time being around three minutes. Changes in the mixing time of the face glue from two to nine minutes did not significantly alter the compressibility values. The content of emulsified air in the core glue mix, however, increased almost proportionally to the mixing time.

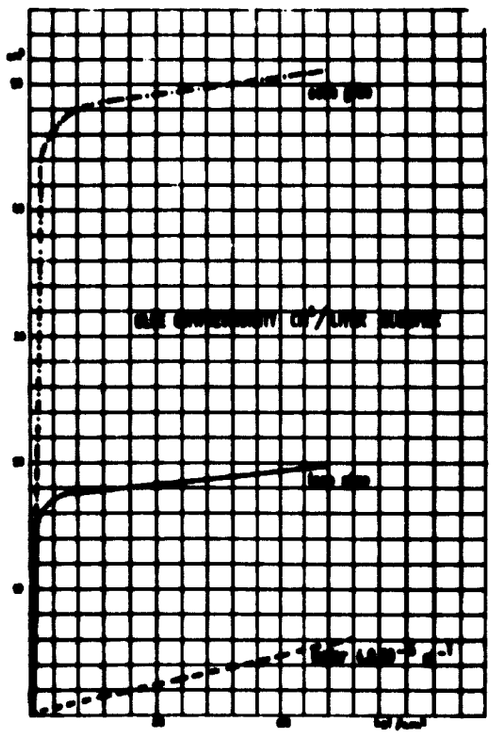


Fig. 13
Compressibility of glue mixes

It can be seen clearly from the above-mentioned curves that each of the measured glue mixes consists of a gaseous and a liquid component. The portion of air included in the glue at a normal pressure can be read off at the point where the hyperbola turns into a slightly inclined straight line. The air volume incorporated in the glue mix is very different for core and face glue mixes due to the different solids content, but it is influenced to a great extent by the design of the blending apparatus. The following table shows the air content and density of the glue mix.

Stirrer	Face Glue	Core Glue	Air in Glue Mix cm3/liter	Density g/cm3
	x		23	1.163
300 rpm		x	65	1.128
	x		16	1.191
300 rpm		x	19	1.161

It must be pointed out here that air inclusion does not necessarily exert a substantial negative influence in all cases. The accuracy of the glue flow reading will depend strongly upon the glue flow control equipment used in the plant.

The compressibility of the glue mix as a function of blending time is indicated in the following graph.

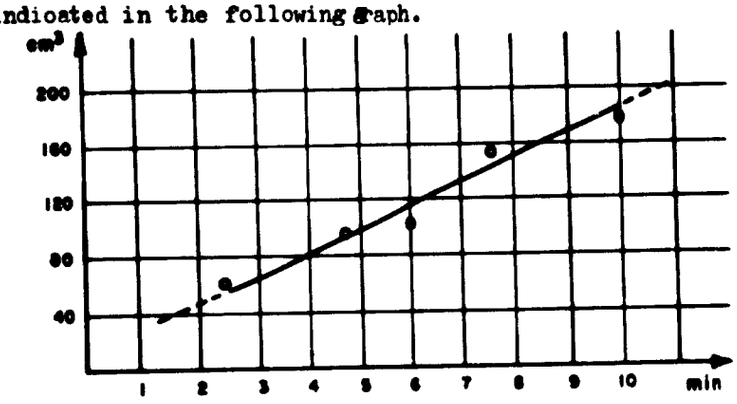


Fig. 15
Compressibility of glue mix in relation to the blending time

Consequently, under the plant conditions, nearly 20 per cent of the volume of the glue mix would consist of air if the blending time were ten minutes. Extended blending times may consequently lead to false conclusions as to the actual glue flow rate to the glue spreader. In view of the fact that after an extended blending time saturation should take place, it is, of course, surprising that within the range of these measurements, the air absorption of the glue is practically proportional to the mixing time. The effect of the number of revolutions per minute on the amount of air dispersed in the glue mix depends on the type of mixer used. High-speed mixers or the so-called Ultra Turrax agitators with 5000 to 8000 rpm can even deaerate a glue mix if the mix is not agitated for more than 50 to 60 seconds. As a rule, however, the amount of air dispersed increases with increasing speed of rotation. Finally, it must be stated that defoaming agents have had no influence on the compressibility of the glue mix, i.e. on the amount of air dispersed in the mix.

As shown above, the air dispersed in a glue mix is not a desirable ingredient for accurate dosing of the fluid. At the end of the last decade, however, foaming mixers were up-to-date, especially in the plywood industry, but they have been replaced by other equipment. Today's precise roller coaters for the application of glue to the veneers do not require more a low density glue mix. The air in the glue mix did never help to improve the quality of the glue line. Nevertheless it is surprising that a patent has been applied recently for foaming the glue mix for flakes as used in the particle board industry. The foamed glue should, according to the patent, show a better yield in connection with the modern type of horizontal blenders where the glue is applied by means of centrifugal force.

3.2.2 Static mixers

Instead of agitator tanks, static mixers could be considered. Because of a certain pressure requirement, however, such mixers can only be used in connection with dosing pumps as mentioned in section 3.1.5. The purpose of such a mixer is to mix the different fluid media continously in parallel streams, whereby, only the fluid moves and not the mixer. By using solely the flow energy, an even, homogenous distribution of the different components is achieved. The mixing energy is supplied by the pumps. For a glue mixing station, static mixers are advantageous in that they consist of a closed system. Moreover, no high-speed agitator is needed and therefore, no air can be emulsified in the glue mix, so that the dosing accuracy of the flow of ready-to-use glue to the glue spreader is enhanced.

A static mixer is composed of several mixing elements. As a rule these are staggered in a pipe. Each element consists of perforated plates or spirals which are arranged in such a way that they form channels crossing each other. For mixing the glues and chemicals normally applied in the timber industry, the channel size and spiral geometry can be very simple. For a simple mixing problem with pro-

ducts of low viscosities, such as used for glue preparation, a mixer length of about 3 to 5 times the pipe diameters is sufficient. The thickness of the layer at the end of the mixing process can be calculated relatively simple, since it only depends on the diameter of the pipe and on the number of mixing elements. Thus with a pipe diameter of only 30 mm and 10 spiral baffles, the thickness calculated for the layers is less than .05 mm, the average flue droplet diameter being definitely larger. An additional guarantee of perfect mixing is provided by the turbulence in the static mixers and the commonly used intermediate tanks with slow agitators. Fig. 16 and 17 below illustrate the principle of a station with six media to be mixed and the static mixer.

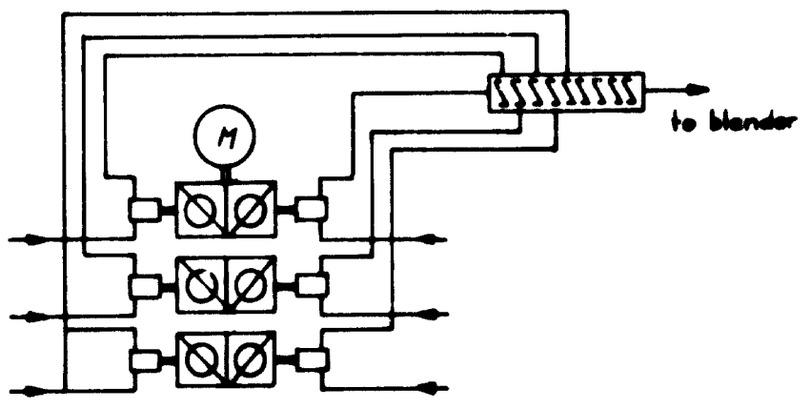


Fig. 16
Station with six media outlets

Fig. 17
Static mixer

The unit becomes very compact if no intermediate tanks are installed beyond the mixer. However, some plants prefer to use intermediate tanks in order to avoid down time on the forming line in case of failure of a valve in the pump. Others are delighted not to have any freeze-up of glue in the tanks and no lumps of glue. Cleaning of the mixer and the main glue line is done manually or by pneumatically actuated valves, which rinse the system with hot and cold water. The maintenance required for such a mixer is negligible; in general it is dismounted once a month and cleaned mechanically. Some plants have eliminated the flow meter in the glue line leading to the glue spreader and just count the strokes of the glue dosing pump. Evidently the accuracy of the dosing pump must have been better than that of the flow meter.

4. Storage of ready-to-use-adhesive

It has become a question of necessity and trust in the equipment as to whether one uses buffer tanks for the ready-to-use glue or not. Since most plants still use conventional stirrers for a well balanced mix buffer tanks are indispensable. For UF, PF and wattle adhesives, very small buffer tanks with a capacity of 100 to 200 litres are common in plywood and veneering plants, whereas partioleboard plants use tanks holding up to 500 litres. These buffer tanks are preferred in modern automatic glue preparation systems, and have a slow agitator with a speed not higher than 40 rpm to defoam the adhesive. A study has shown us that air that has been emulsified into the glue mix during the balancing period is released again under the influence of slowly running agitators in buffer tanks. If the glue mix is transferred from the mixing tank ti a buffer tank and agitated very smoothly for about 20 min., most of the incorporated air is released again.

	Face glue	Core glue
Air content after balancing	23 cm3/h	65 cm3/h
Density	1.163 g/cm3	1.128 g/cm3
Air content after agitation	6 cm3/h	17 cm3/h
In buffer tank	1.204 g/cm3	1.167 g/cm3

Steel, aluminium or PE tanks are suitable for this purpose, but steel tanks do not look very good because of the rust, which develops.

5. Problems experienced with glues, adhesives and equipment

The most frequent accidents in this section are glue freeze-ups in the tanks or pipes. If polymerisation of the UF glue has reached an advanced stage but the glue has not yet solidified, the addition of ammonia shall strictly be avoided. It is not generally known that ammonia increase the viscosity of UF glue, and if a pipe or tank filled with glue comes into contact with ammonia the viscous binder will solidify within a short time. Warm water, up to 50°C, is the best solvent in such a case. Freeze-ups of phenolic or wattle binder very seldom occur.

UF adhesive pipelines to the glue spreader should be flushed with warm water once a week. There seems to be no problems of any kind involved in processing UF and PF glue consecutively in the same equipment. If UF and wattle glue contact each other, they generate a rubber-like compound which necessitates dismounting of the equipment in order to clean it thoroughly. It is, therefore, strongly recommended to use completely independent equipment for wattle and urea adhesives.

As was mentioned in the preceding section, erratic glue consumption readings may occur when two consecutive glue batches show different densities caused by air dispersion due to excessive stirring. To avoid this a timer should be used to limit the mixing time to 2 or 3 minutes. Further slow agitation in intermediate tanks will help to keep adhesive density within a small range.

Foaming of the paraffin emulsion sometimes causes problems with regard to the equipment. Here too , defoaming agents do not help much. With the proper technology molten wax can be applied to the flakes or an emulsion with a low solids content, which will foam less, can be used.

6. Simple testing procedure to assure uniform adhesive quality

- Check the viscosity and pH of the raw liquid glue daily;
- Check on gel time will indicate whether all the ingredients are present in the adhesive in the proper proportions as specified in the formula. In order to shorten this testing procedure, it can be carried out at raised temperatures, using oil instead of a water bath;
- Checking the pH of the ready-to-use adhesive can also be useful if it is not determined by a specific acid or base used as an ingredient (e.g. as in the case of UF glue).
- Accurate checking of the density of the ready-to-use glue permits an accurate evaluation of the glue mix.

7. Drainage water treatment

As the equipment described in the previous chapters has to be cleaned thoroughly, the drainage water will therefore contain small amounts of resin salts, acids or bases, starch etc. In case no precise restrictions exist with respect to the treatment of this sewage water, it is recommended that certain simple rules apply to the following:

- Phenolic or resorcinol glue is detrimental to the fauna of rivers and lakes. The drainage water should therefore pass through a sedimentation tank and as much water as possible should be reused for diluting the glue.
- Urea glue is less problematic. The water should also pass through a sedimentation tank but not be used again as diluting water, because the acidity of this water has too great an effect on the gel-time of the ready-to-use glue.

The use of sedimentation tanks for the drainage water is also advisable from the point of view of clogging the drainage pipes between the plant and the community sewage system.

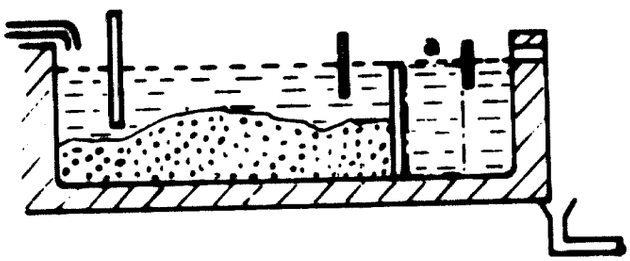


Fig.18
Sedimentation tank

Fig. 18 shows a suitable sedimentation tank as recommended by most glue suppliere. It consists of an approx. 6 x 1 m concrete or steel basin with a number of barriere. So far, we have had good experience with gravel in a certain part of the basin because the sediment is easier to remove. In case of phenolic waste water, section "a" should preferably be a box with a charcoal filter. Foam, the charcoal and the gravel containing the sediment are removed about once every other week in large plants.

8. Bibliography

DOS 24 29 534, Becker u. van Hüllen 1974,
Verfahren zur Aufbereitung von Bindemitteln

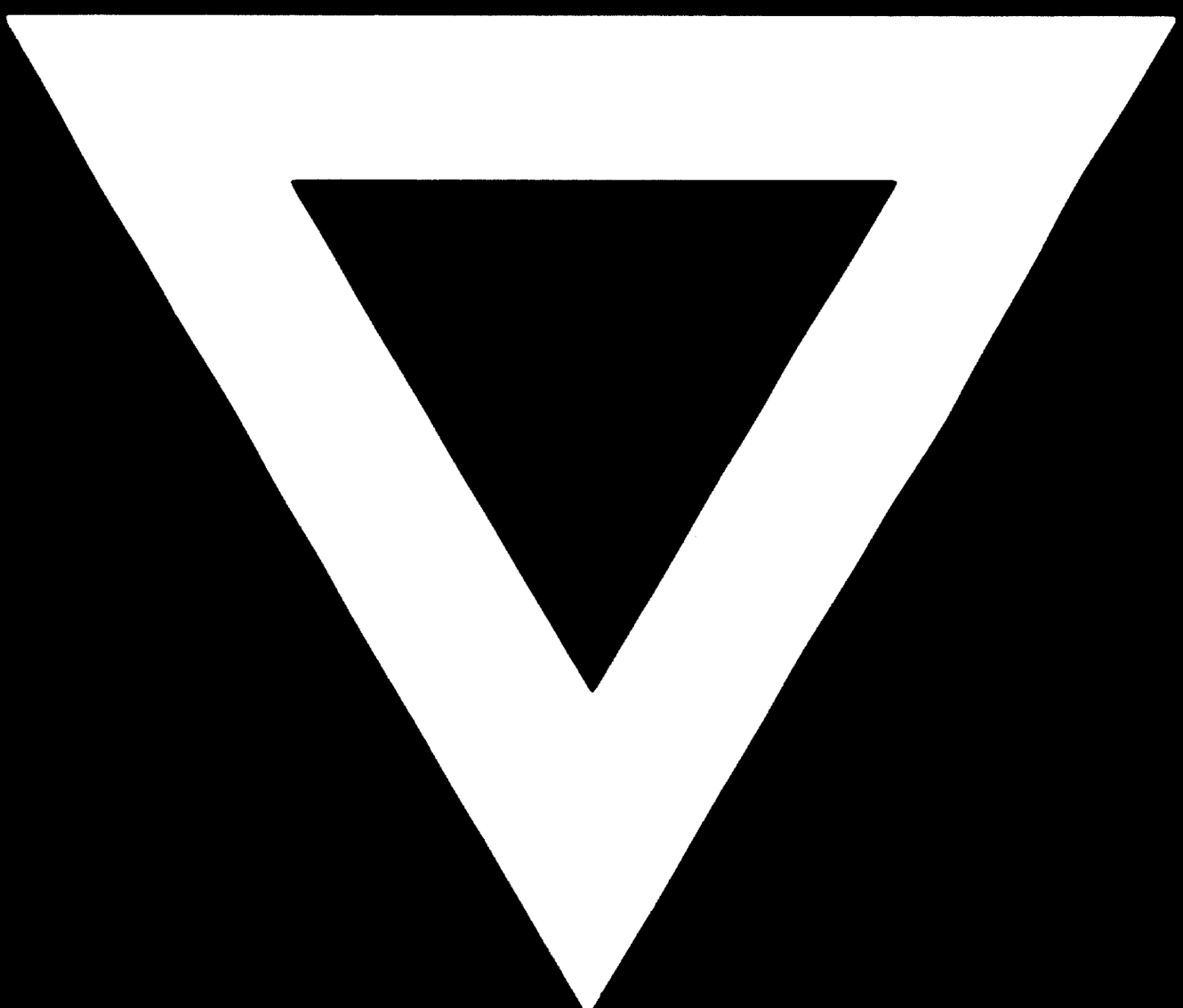
K. Kull, Holz als Roh- und Werkstoff 34, 1976, Heft 10

S. Senn, Proceedings of Ninth Particle board Symposium, 1975

BASF, Technische Information, Leimharze

ICI, Ref. TS-176, Urethane Chemicals

C-669



78.11.08