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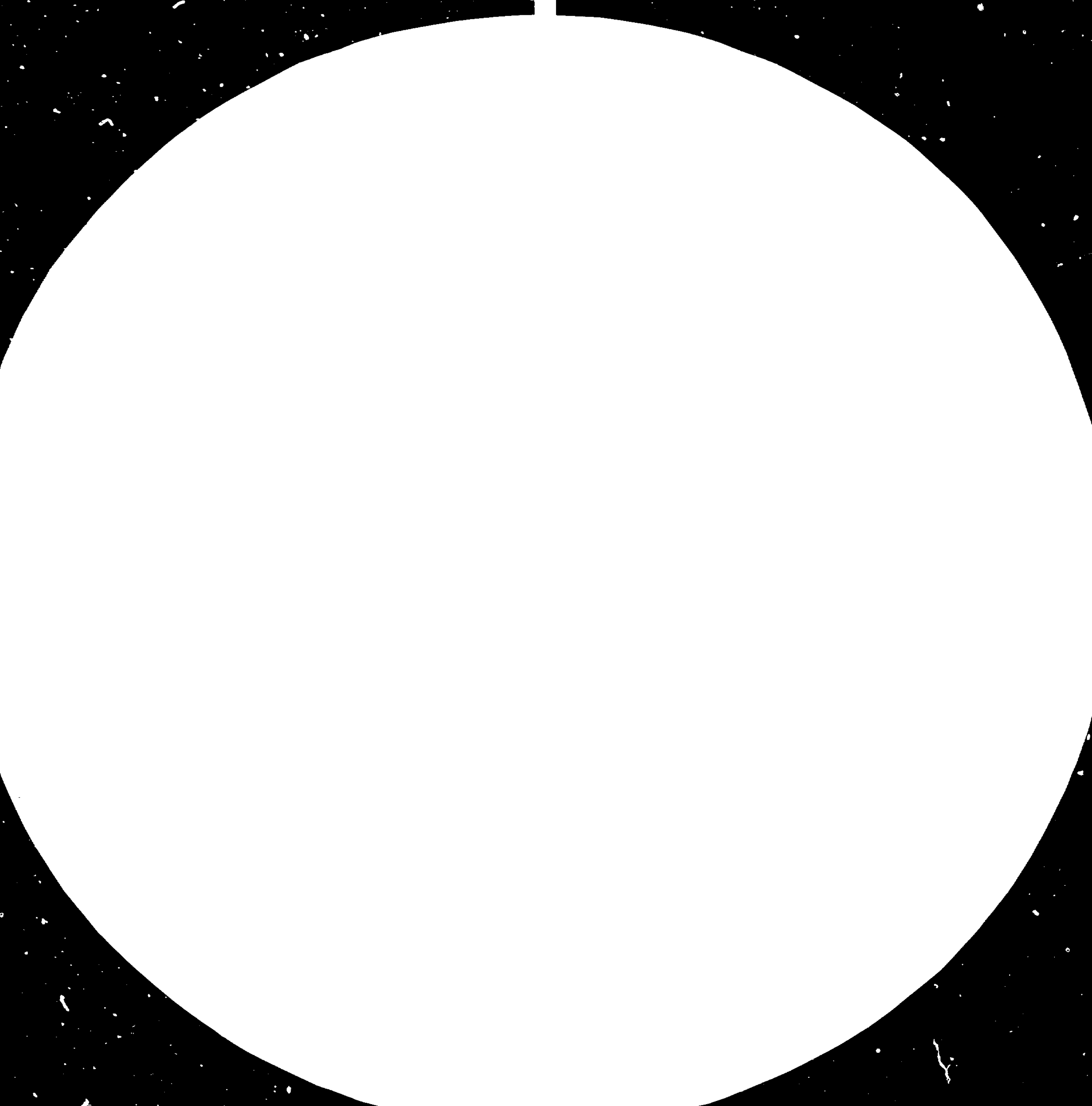

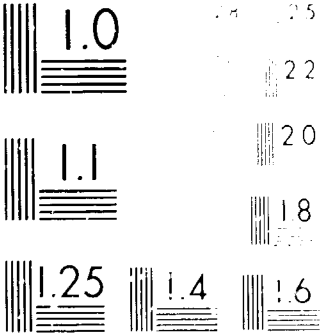
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CUBAN EXPERIENCES ON NEWSPRINT FROM BAGASSE *

by

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At an international meeting of pulp and paper experts sponsored by UNIDO and FAO in Vienna in Autumn 1979, the majority of the experts agreed to support the generally expressed idea of concerted effort on the part of UN specialized agencies and interested countries to build and operate experimental facilities to carry out research on a meaningful scale to develop and demonstrate technico-economically feasible technologies for the production of newsprint substantially from bagasse.

To the majority of those present at this meeting it was quite obvious that all processes available had not fully considered the basic and recognized economic requirements of newsprint production throughout the world.

In the 1950s based on bagasse chemical pulp, a mill for the manufacture of commercial newsprint was built in Cuba, but the process proved to be impractical both from a standpoint of producing a proper quality newsprint and from an economic standpoint, and 1960 it was decided to discontinue the expensive newsprint program and shift production of the mill to second-class writing and printing, for which bagasse chemical pulp was obviously better suited.

The Cuban Government, fully aware of this need and anxious to develop commercial scale production of bagasse newsprint, has taken up a project with precisely these objectives and commissioned The Cuban Research Institute of Sugar Cane By-products (ICIDCA), to carry out basic laboratory research to assist project engineering and future investigation at the pilot plant.

In March 1974 the Government of Cuba, with the assistance of United Nations Development Program (UNDP) and the collaboration of the United Nations Industrial Development Organization (UNIDO) started this ambitious program. The program also comprises experimental and demonstrative work for the production of dissolving grade pulps 100% of bagasse, thus further diversifying the bagasse industry of many developing nations by opening the door to artificial textiles fiber and cellulose industries in general at the expense of a very short reproduction cycle of fibrous raw material.

Actually an experimental mill designed and equipped with commercial-size equipment is ready to start up, to introduce and demonstrate in real mill practice, the laboratory scale results obtained in Cuba during the last 10 years in newsprint and dissolving pulp from bagasse.

Well-known and prestigious researchers had demonstrated, both at laboratory scale and experimental machine trials, that in the production of newsprint from bagasse, technical and economical gaps still present in available technologies leave ample room for improvement which could be solved by another technological way.

For the utility of the participants attending this working meeting we would like to present in a summarized report aspects we consider of importance for bagasse newsprint production.

BAGASSE RAW MATERIAL

From the point of view of bagasse utilization for papermaking purposes, its own characteristics must be taken into account. especially for newsprint production.

Bagasse, just like hardwoods, reacts in a very different way than softwoods, and it should be remembered that it contains a considerable amount of parenchyma cells and vessel elements, that together with the quantity of fines formed during refining, negatively influence the strength properties of the sheet.

Since sugar mill operation usually extends for a period of 3-6 months and since pulp mills must operate over the entire year, it becomes necessary to store large quantities of bagasse to ensure a steady supply to the pulp mill.

As a result of progress in the development of bulk storage methods, such system has become universally accepted because of appreciably lower investment and operation cost. However, to reach this almost total acceptance developers of bulk storage had to find ways and means to limit deteriorating processes based on the 4-6% residual sugar presented on bagasse coupled to ideal fermentation moisture and temperature conditions.

Table 1 gives a clear picture of deterioration of bagasse by uncontrolled bulk storage. Cellulose has deteriorated and degraded to a noticeable extent while a large loss of brightness has occurred.

Fortunately such a problem has been solved. A system with microbiological-controlled fermentation of residual sugars pro-produces bagasse keeping all its fibre physical characteristics of flexibility, strength and brightness without chemical degradation.

Today it is a recognized fact that pith is not a paper making material. Such criterion has not come without pains. Present depithing know-how makes it possible to reach 85 ± 1% fibre content bagasse through a well-balanced moist screening-microbiological storage-well depithing system avoiding high fibre losses due to excessive mechanical action as well as making use of depithing effects of the storage.

Upgraded bagasse fibre characteristics may be observed in Table No. 2. We have found that these processes are fundamental steps for this kind of paper.

PULPING PROCESSES

Through the analysis of the research work and industrial processes carried out on this subject, combined with our own experiences, it became quite evident that the problem of technical and economical production of newsprint from bagasse would necessarily shift away from the chemical approach.

During recent years the refiner mechanical pulping process has come into widespread use to produce mechanical pulp from hardwood which was considered not available for such a purpose. Further development in this field gave us the reason to believe that similar types of mechanical pulps can be produced from bagasse.

Based on this idea, a large number of trials have been made at laboratory scale, dealing with mechanical and chemimechanical pulping of bagasse in order to evaluate the properties of these pulps.

Various pre-treatments of bagasse, refining conditions and disc patterns have been evaluated and these results which are quite promising are already available for proving at semi-commercial scale, avoiding economical risks.

Table No. 3 presents a comparison of Spruce Groundwood, mechanical, NaOH pretreated and alcaline sulfine bagasse pulps.

It is evident that pretreatment increases pulp strength characteristics notably. Increases in the very important tear factor are of the order of 40 and 55% respectively compared to straight mechanical results.

It is convenient to recall the normally lower properties development capacity of laboratory refiners compared to full-size equipment. Such increases in strength properties would place bagasse refiner chemimechanical pulps by either of the two pre-treatments well above groundwood properties, thus making it theoretically possible to use mixtures of bagasse chemimechanical and straight mechanical pulps to take advantage of optical-properties of the latter pulp as well as lower cost of production.

BRIGHTENING OF MECHANICAL TYPES OF PULP FROM BAGASSE

In the last two years a great part of our laboratory research work has dealt with the study of the most appropriate technology for brigthening of RMP and CRMP from bagasse to the newsprint requirements with particular attention to the brightness and preservation against aging.

Concerning pulp brightening the experience of our research has shown that it is not advantageous to use always the reported conditions for wood pulps as a logical consequence of the morphological and chemical differences between both raw materials. The results of bagasse pulp brightness using different oxidant and/or reducer reagents are shown in Table No. 4.

The pulps obtaining both mechanical and chemimechanical were easily brightened without impairing physical properties of the pulp.

Regarding pulp brightness for newsprint production, the results are specially advantageous when hydrogen peroxide is used not only because of the brightness increase, which allows to obtain 58-60 (Elrepho), but also because of the color stability with age.

In this sense the hydrosulphite is also a very suitable option by means of which a final brightness of about 56-58 (Elrepho) is obtained but pulp brightnesses are relatively not steady to age, compared with those brightened with hydrogen peroxide

Through the combination of both stages we can obtain a chemimechanical pulp with a 66-68 final brightness (Elrepho), which means an answer to the paper demand when brightness is not a fundamental factor, but the printing properties are an important aspect on this type of pulp.

Finally it has been shown that the hypochlorite is not a satisfactory variant for bagasse brightening schemes due to the marked brightness reversion it suffers with aging.

These results are extrapolables to mechanical pulp.

PRINCIPAL FEATURES OF THE EXPERIMENTAL PLANT

To back up the ambitious experimental program described above, careful design of the experimental plant started as early as 1973 in the engineering division of ICIDCA.

The requirements of minimum-size machinery to make the plant fully representative of commercial size units as well as the desire to keep within budget limitations, were the basic guidelines used. Engineers were pressed by technologists and research scientists to incorporate more and more process flexibility to the plant in order to make it useful not only for the two initial objectives of Cuba-9 Project, but also to accommodate future requirements of R&D tasks. Sophisticated plant instrumentation is another feature of the plant. The end result of careful design and construction is a bagasse pulp and paper mill that can be considered unique in the world.

The site selected to construct the experimental plant is 200 meters away from the Pablo Noriega sugar mill, 50 km. south of Havana.

This mill, the smallest in Cuba, has a grinding capacity of 900 tons of cane per day and has been selected as the experimental sugar mill of Cuba's sugar industry. An intensive research program covering new processes and machinery as well as testing of industrial influence of new cane varieties and new crop methods in sugar making technology is the principal activity of this sugar mill. The pulp and paper plant will nicely tie into this research program and a more integral vision of sugar cane industrialization will be obtained for the future development of this industry in Cuba.

BAGASSE STORAGE AND PREPARATION AREA

The nearby Pablo Noriega sugar mill is the only supplier of bagasse to the experimental mill. This mill is equipped with an ample cane preparation station, thus the bagasse is delivered with pith and fiber separated to a large extent. First stage depithing takes place in the sugar mill. Separated pith is mixed with molasses and urea to sell as cattle feed; alternatively, starting next year, it will be burned in a pith boiler of Cuban design. After depithing, the bagasse is conveyed to a mixing tank where either back water from the pulp and paper plant or fresh water from the pulp and paper plant, fresh water or microbiological liquor is added to the incoming bagasse, slushed to 2% consistency and pumped to an overhead loader at 20 meters elevation, from which bagasse is dropped to the storage pad.

The storage pad is fitted with an elaborate liquid recirculation system for recycling purposes. A fermentation station is available to produce the microbiological liquor for bagasse impregnation, when required.

Bagasse is reclaimed from the storage pile using bulldozers and front-end loaders, conveyed to a hydrapulper where it is slurred and pumped to a drainage conveyor situated in the pulp plant building. Separated pith goes to sewage and a secondary wet depithing takes place in a horizontal depither prior to dewatering in a screwpress to bring up the consistency.

PULPING STATION

With the idea to pulp bagasse in any conceivable way the design of the pulping plant was a very complicated job. The installation is built around the following basic equipment: a continuous horizontal 2-tube digester manufactured by Black-Clawson Kennedy in Canada; a rotary batch digester (45 M^3) by Scholz in West Germany; a mixer-impregnator of local construction; two 42-inch disc refiners by Defibrator in Sweden, a blowtank; three vacuum washing filters by Canron, Canada, and conventional screening and centricleaning stations by Hymac, Canada, and Celleco Sweden respectively.

Operation pattern of the plant is built around the concept of the multiple or alternative use of the equipment for all process requirements.

To exemplify this idea let us take what might be considered the two ends of process spectrum, that is, mechanical pulping and dissolving pulp production. In the first case the mixer-impregnator and continuous digester simply convey the bagasse to the two-stage refining operation while in the second, the rotary batch digester is used for prehydrolysis and alkaline cooking together with the blowtank. The vacumm washers are used for brown stockwashing and later in CEH bleaching sequence.

Through interconnections, chemimechanical, semichemical, chemical, as well as thermomechanical and even ultrahigh yield pulping processes are within reach of this unique pulping plant. The rated estimated capacity of the pulp plant is 20-25 tons/day for continuous operation in case of mechanical type pulps and 5 tons/day for discontinuous production of dissolving grade pulps.

BRIGHTENING OR BLEACHING STATION

Design of this part of the plant introduced savings in capital costs by avoiding equipment duplication and making use of batch operation approach to avoid the costly brown stock washing line in the case of bleached chemical pulp production. The bleaching towers were also designed with the idea of alternative use for either peroxide/hydrosulphite brightening or CEH bleaching process as required.

The installation available is able to brighten continuously 25 mt of mechanical or chemimechanical pulp using peroxide or hydrosulphite process. By operation on a discontinuous fashion it is able to act as brown stock washing and CEH bleaching station thus minimizing investment costs without giving up the capacity to do research work in these processes.

The final step in the pulping installation is high density storage of pulps produced in two 150 M^3 high-density storage towers, thus making it possible to store and later meter two different types of bagasse pulps produced to the stock preparation station.

STOCK PREPARATION

The stock preparation area is conventionally designed to handle imported wood pulp, two types of pulp produced within the experimental mill and several chemical additives.

The imported pulp is slushed in a hydropulper and beaten in disk refiners. Metering of the stock to the paper machine is done through a fully instrumented system and a Lewa metering pump.

PAPER MACHINE

The experimental paper machine was supplied by Cver in Italy, under license by Dominion Engineering. The machine wet section has a cantilever fourdrinier with pressurized headbox, an extra long wire and overdimensioned dewatering capacity with polyethylene foils and suction flat boxes.

A suction pickup and double press arrangement with grooved second and third nips, account for the press part of the machine guaranteed to obtain 40% dryness of the sheet.

The dryer section consists of 36 dryer rolls one of which may operate as a sweat roll, divided in four groups. A closed type machine callender, pope reel and slitter winder complete the paper machine.

The paper machine trims at 840 mm as finished roll, has an operating speed of 600 meters per minute and 750 meters per minute balancing speed. A special feature of the machine is that all roll diameters are dimensioned to the size of 4.5 meters width machine in order to test stock runability in commercial size machine conditions.

Auxilliaries of the machine are a complete centralized lubrication system, a steam and condensate system by Reiss of U.K., a thyristor controlled D.C. sectional drive by Siemens of Italy and weight and moisture control by Beltronix of Italy. Studies are under way to outfit the machine with a process computer system.

PULP DRYING MACHINE

To dry the dissolving pulp, as well as to be able to manufacture heavy papers and boards in the future, an old fourdrinier machine is being rebuilt and modernized in our shops in Icidca. This machine trims at 1,200 mm and is able to run at speeds up to 60 meters per minute. Modernization program includes complete reconstruction of headbox and fourdrinier, redesign of press section, covering of dryers with Teflon, and new drive and vacumm system.

SERVICE AND UTILITIES

The construction of the experimental pulp and paper mill demanded the erection of new service facilities integrated with the nearby Noriega sugar mill. Among the most important of these facilities are:

(a) 10 MVa - 33/6.3 Kv power substation connected to the grid.

(b) Water works, including 750 m^3/hour deep well pumping station 480 m^3/hour water softening plant for process use and 40 m^3/hour water softening plant for process use and 40 m^3/hour demineralization plant.

(c) Central repair workshops and compress air station.

(d) Office and Laboratory building.

(e) Social facilities with housing for 100 families.

TABLE NO. 1

CHARACTERISTICS OF WET BULK STORED BAGASSE

	Fresh Bagasse	Wet Bulk Stored Bagasse
Cellulose %	54.2	52.0
Solubility (1% NaOH) %	28.4	40.5
(Hot water)	0.4	0.7
(Cold water)	0.7	2.4
Extractives (AK-Benz) %	1.6	3.6
Pentosans %	21.3	19.1
Lignin %	23.4	23.6
Ash %	0.7	2.8
D.P.	1000	800
Brightness (Elrephc) %	46	30

TABLE NO. 2

INFLUENCE OF DEPITHING ON CHEMICAL AND PHYSICAL CHARACTERISTICS OF BAGASSE

	Whole Bagasse	Depithed Bagasse
Cellulose %	49.6	54.2
Pentosans %	23.3	21.3
Lignin	20.2	23.0
Ash	4.3	0.7
Solubility % (1% NaOH)	38.1	28.4
(Cold water)	3.4	0.4
(Hot water)	4.1	0.7
(AK-Benz)	2.5	1.6
Fibre ontent (dry basis) %	67.2	86.1
Pith content (dry basis) %	32.8	10.4
Brightness % (Elrephc)	46.0	48.0
Fibre Classification %		
R. on 2.5 mesh	35.4	36.1
R. on 6 mesh	18.6	9.0
R. on 10 mesh	20.3	24.9
R. on 16 mesh	9.3	27.0
R. on 16 mesh	16.1	3.0

TABLE NO. 5

CHARACTERISTICS OF BAGASSE RMP AND CRMP

(Laboratory Scale)

	Spruce Groundwood (mill scale)	RMP Bagasse	Bagasse Alcaline Sulphite CRMP	Bagasse NaOH CRMP
Freeness (CSF), ml	34	110	110	110
Bauer Mc Nett Fiber Classification (%)				
R - 28	14.0	5.4	27.4	30.0
R - 48	23.6	11.8	18.7	13.0
R - 100	16.1	12.6	18.7	17.0
R - 200	13.9	22.6	12.3	13.0
Density Kg/m^3	525	309	374	337
Tensile index Nm/g	26.0	12.0	24.0	21.0
Tear index mNm^2/g	3.5	1.6	4.3	3.[illegible]
Burst index KPa m^2/g	1.4	0.8	1.4	1.2
Brightness %	58.10	45.0	44.6	38.0
Opacity %	96.0	97.0	97.7	98.4
Light Scattering m^2/kg Coefficient	67.9	55.0	41.2	44.0

TABLE NO. 4

PROPERTIES OBTAINED FOR BRIGHTENED MECHANICAL AND CHEMI-MECHANICAL BAGASSE PULPS

Property / Brightening	Brightness (Elrepho)	Opacity %	Post Colour Number
Chemimechanical Pulp			
Peroxide	57 - 62	93 - 95	1 - 2
Hydrosulphite	58 - 60	94 - 96	3 - 4
Peroxide-hydrosulphite	65 - 67	93 - 92	1 - 2
Hypoclorite	55 - 57	93 - 95	14 - 20
Mechanical Pulp			
Peroxide	59 - 60	94 - 96	2 - 3
Hydrosulphite	60 - 62	95 - 96	3 - 4
Peroxide-hydrosulphite	65 - 67	93 - 95	3 - 4