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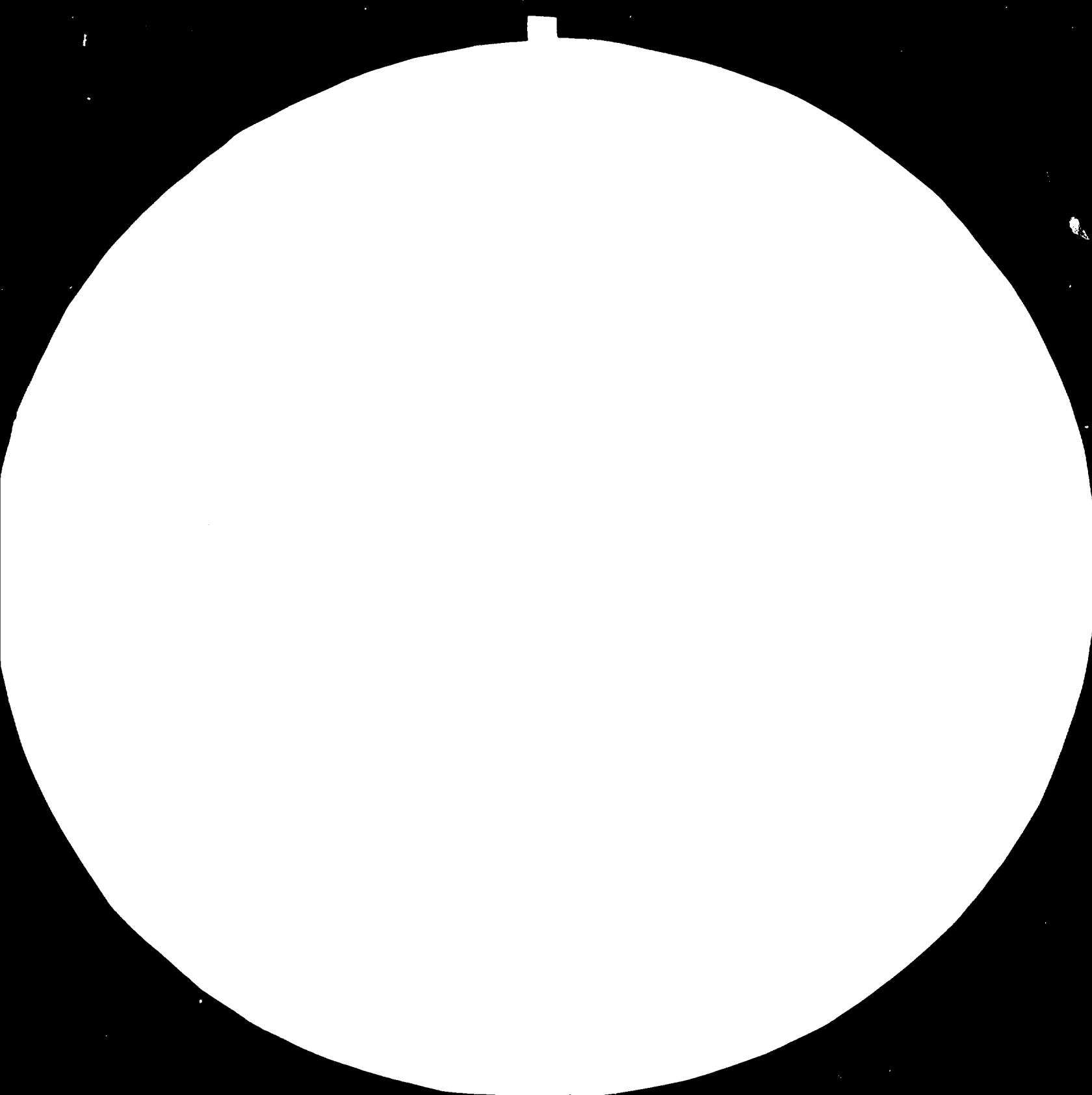
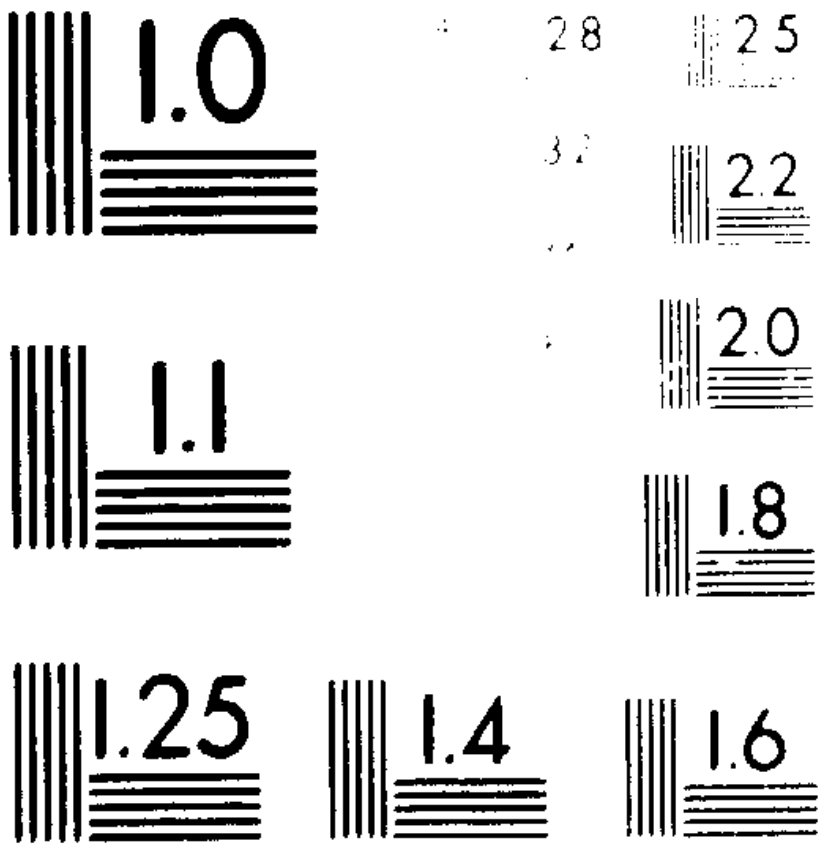
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





18 September 1984

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China.

TECHNICAL CENTRE OF PULP AND PAPER MAKING

(DP/CPR/81/027)

Report on Second UNIDO Mission to Beijing

by

S.T. Han
UNIDO Expert

STH

REPORT ON SECOND UNIDO MISSION TO BEIJING

As outlined in the original project document submitted in November, 1982 to UNDP and UNIDO by the Paper Industrial Research Institute, the Ministry of Light Industry for funds to establish a chemi-mechanical pulping pilot plant and its associated training programs, my second mission is to evaluate the progress of the project and to further assist the Institute in the preparation of its next stage of development into a national pulp and paper R&D center. After some preliminary arrangements in June, 1984 the mission, shortened from one month to ten days, was finally scheduled from August 23 through September 1, 1984 under an amendment to the special service agreement DP/CPR/81/027/11-01/32.1.E.

The actual schedule is summarized as follows:

8/23/84 Arriving Beijing

8/24/84 Briefing at UNDP

8/25/84 Scheduling work with Institute staff

8/27/84 Inspecting and evaluating pilot plant progress

8/28/84 Reviewing chemi-mechanical pulping research

8/29/84 Discussing experimental papermachines

8/30/84 Appraising project progress with UNDP and MLI staff

8/31/34 Discussing future work

9/3/84 Lecture on wet pressing

9/4/84 Seminar on press drying

9/5/84 Seminar on wet end chemistry

Seminar on paper physics

9/14/84 Leaving Beijing

Chemi-mechanical Pulping

The Sunds-Defibrator chemi-mechanical pulping pilot plant equipment is housed in a new building on the Institute's premise. At the time of inspection it was completely installed, ready for the Sunds-Defibrator engineer's supervision of the initial test run. His arrival was expected on the day of my departure. No serious operating problem was anticipated.

In the interim of my two visits the Institute's research staff has done a great deal of work on chemi-mechanical pulping using laboratory equipment as I previously suggested. They have investigated the jet-alkali method of improving poplar groundwood pulp and sulfonation of aspen and spruce chips for chemi-mechanical pulps, both with good results. In addition, several wood species and cotton stalk have been evaluated for their suitabilities as potential raw materials for paper and board. In my discussions with the staff, I was particulary intrigued by the possibility of utilizing the otherwise useless cotton stalk if the difficulties of collection, storage, cleaning, defibration and decoloration could be resolved.

Experimental papermachine

Having been satisfied with their research progress, I proceeded to explore the question of setting up an experimental papermachine as a logical next step of the Institute's development. Their basis for an experimental papermachine is the need of practical investigations of the two sidedness of printing paper caused mainly by a high proportion of very short fibers, especially those of straws. I agreed with them that a fourdrinier with an additional top forming unit would be suitable for their purposes. However, I pointed out that at their moderate speeds,

not just any top unit would do. I promised to look into this question after my return to the States.

Press Drying

In my first visit I suggested that the press drying process as developed by the Forest Products Laboratory in Madison, Wisconsin, for making linerboard from hardwood could be a possible solution for developing countries short of softwood. As the process stands now, its application at high speeds involves some serious difficulties. In most experts' opinion, the development of a low-speed press drying machine is feasible with the existing technology. As a participant in some of the work at the Laboratory I shared their outlook. Since the Institute's staff has showed similar interest in press drying, I promised to make arrangements for one of their engineers to work at the FPL in this area.

Paper physics

Paper testing and evaluation is an important part of the Institute's role as a national paper R&D center. As this has been outside my research areas, I only made a cursory introduction at the seminar. I suggested to invite Dr.D. Page of PPRIC to give a series of lectures on the subject in a UNIDO mission similar to that with Dr.D Atack in 1983, which was exceptionally well received.

Perspective

The development which the Institute is vigorously pursuing with the aid of UNIDO and UNDP is not only important for the Chinese paper industry, but hopefully, with its new facilities and foreign trained R&D staff may also serve as an experimental station for other developing countries with similar problems of raw materials and paper requirements.

Copies of summaries presented by the Institute are attached for reference. These are:

1. Implemention of Project
2. Follow up Activities
3. The Jet-alkali Process for Chemi-mechanical Pulping of White Poplar and Cathay Poplar for Newsprint
4. Sulfonated Chemi-mechanical Pulping

S. T. Han

September 18, 1984

IMPLEMENTION OF PROJECT

DP/CPR/81/027, project of technical centre of pulp and paper was approved on Dec. 23, 1982. This project is devoted to produce newsprint and its related paper grades with indigenous fibrous raw materials with new pulping technology, chemi-mechanical pulping. A pilot plant for chemi-mechanical pulping will be installed, and a series of laboretory researches and training of technical personal were arranged accordingly.
A summary of project implementation is presented as follows:
Prior to the finalizing the project documont, a investigation tour and a visit by project consultant, Prof. S.T.Han were arranged by UNDP. The investigationgroup visited 14 pulp and paper research institutes in Sweden, Finland, and USA. The research and development activities, and research facilities, especially the pilot plant installations of these institutes were studied. The investigations group found that the chemi-mechanical pulping is the pulping method deserved to devote our research efforts. The reason is that this process with its high yield, low pollution, and low investment cost can use indigenous raw materials effectively for newsprints and related paper grades which is urgently demanded by chinese paper industry. Accordingly a compact and effective pilot plant set should be installed. Prof. S.T. Han, consultant of this project came for his first visit from Oct. 15 to Nov. 15, 1982. He gave suggestions for the choise of chemi-mechanical pilot plant unit for the research activities, for the training program, and for the nomination of the congultant for research and development of the chemi-mechanical pulping. All his suggestion were accepted and thus this project document was finalized. His lectures in the field of chemi-mechanical pulping and paper making is very helpful to the research scientists and engineers.

OUTPUT

I. CONSULTANTS

Mr. Atack, consultant for mechanical and chemi-mechanical pulp arrived in Beijing on June 4, 1983 for two weeks. He gave lectures and discussions in the field of mechanical and chemi-mechanical pulping. The major topics are pulp evaluation techniques and testing instrument; the effect of various operating parameters in grinding and refining; the relative effect of time and temperatures on lignin softening; design parameters for refiner plate patterns affecting fibre separation, strength development and printability factors; and reviewed the plan for the mechanical, chemi-mechanical pulping pilot plant. The lecture given is very helpful to us for the carring-out research work of chemi-mechanical pulping, and two research reports have been completed. Besides, through the recommadation of Dr. Atack, a fellowship was offered by Pulp and Paper Institute of Canada. With this fellowship engineer Huo Yan Zhao is now trained for pulp testing and evaluation. An expert from Sunds Defibrator Inc. is expected to be in China for checking and starting up the pilot plant equipments, which they supplied, in mid August 1984.

II. TRAINING

Two out of the three fellowships under the training programs were implemented.

Mrs. Zheng Shu-min, engineer, was sent to Sweden from Sep. 11 to Dec. 24, 1983. She spent two months in Sunds Defibrator Inc. and six weeks in the Forest Product Research Institute training for the equipment operation and studing research techniques. She is now resonsible for operating the pilot plant unit and training of operators.

Mr. Tan Yong-nian, engineer, was sent to the Finnish Pulp and paper Research Institute for four months, from Oct. 17, 1983 to Feb. 16, 1984, to study the behavior of various pigments and binary pigment in paper coating.

The third fellowship planned for the project of effluent treatment has not yet been arranged by UNDP.

To our regret that the two fellowships implemented which had

been originally planned for six months were cut down to four months.

III. EQUIPMENT

The chemi-mechanical pulping unit from Sunds Defibrator arrived on Dec. 31, 1983. By checking against the packing list, one short supporting leg and six valves were missing. But during the assembling we found that 6 fuse tubes in the motor control panel was missing and there was a blockage in the lubricating system. The equipment is now ready for the inspection and start-up by the engineer from Sunds Defibrator Inc.

IV. GOVERMENT INPUTS / ACTIVITIES

The project personnel has been appointed. The establishment of auxilliary equipments and utilities have been arranged according to the project, but lagged about three months behind the ariginal schedule. The chief draw back was change in design of the steel structure base due to different specification of structure steel used in China.

V. THE RESEARCH WORK ON THE NEW FIBRE RESOURCES

Paper making potential of 4 species of fast growing hardwoods, 2 species of softwood and cotton stalks were evaluated by fibre morphology and chemical analysis. They are quite promising for chemi-mechanical pulping and used in newsprint grades. Cotton stalk is potentially a raw material for packaging board. Two chemi-mechanical pulping experiments were carried out in the laboratory, ie. sulfonated chemi-mechanical pulping of poplar and spruce, and jet-alkali pulping of poplar. The jet-alkali pulp has been used by two mills, The quality of the newsprint is improved, with a significant saving ($> 10\%$). The sulfonated chemi-mechanical pulps give high yield (88—91%) with very good strength. They can be used in newsprint with a wood saving about 10% . This will be further tested by the pilot plant unit. Besides laboratory experiments for chemi-mechanical pulping of four species of wood, cotton stalk, and bamboo will be completed by the end of 1984. Pilot plant trails for these raw materials will be

arranged in 1985. One paper mill proposed to run pilot plant trails for their poplar to be used for their newsprints and offset magazine paper.

VI. CONCLUSION

The project has carried out quite satisfactory. The pilot plant unit is ready for start-up. Two fellowships are expected to be arranged. Further aid from UNDP is expected for the next stage development.

PROGRESS TOWARDS THE ACCOMPLISHMENT OF

PROJECT OUTPUTS AND IMMEDIATE OBJECTIVES

(1) Start up and trial runs for the chemi-mechanical pilot plant unit (Sep. — Oct.).

Pilot plant experiments for sulphonated chemi-mechanical pulping of poplar and high yield cotton stalk pulp for board.

(2) Two fellowships to be arranged : one for waste water treatment and one for pressdrying process for manufacturing board with hardwood.

(3) Purchase of testing instruments with surplus in the budget.

SCHEDULE OF FUTURE PROJECT ACTIVITIES

1. Inspection and start-up the pilot plant unit.

   Sep. 1984

2. Trial runs for the pilot plant unit.

   Oct. - Nov. 1984

3. Pilot plant trial for suphonated chemi-mechanical poplar pulp.

   Dec. 1984

4. Two fellowship to be arranged before the end of 1984.

5. Purchase of testing istruments with surplus in the budget.

   Nov. 1984

FOLLOW UP ACTIVITIES

The next stage of developement will be aimed to the effective use of the chemi-mechanical pulps. The research activities and the training program will be devoted to use various chemi-mechanical pulps along with the straw pulp as the major furnish for printing papers (i.e. newsprint and related grades) and boards. A pilot plant paper machine will be needed for these research and development. This paper machine is expected to be able to dewater at both sides so as to minimize, the two-sideness and lintering problems which are the paper defects, usually resulted when higher percentage of chemi-mechamical pulps and straw pulps are used in the furnish. The cost of this paper machine will be rather high. We proposed to be designed by foreign experienced paper machine manufacturer and major part of the machine made in China.

The Jet-alkali Process For Chemi-mechanical Pulping Of White poplar And Cathay Poplar For Newsprint

—Summary—

In order to improve the properties of groundwood pulps, the Jet-alkali method have been investigated. The results showed substantail improvements on tensile, tear and wet strength, but accompanied by brightness reduction.

The investigation also showed that alkali charge affects properties of chemi-ground pulp of poplar during grinding. If 2.8% of alkali based on dry fiber is used, tensile and wet strength of the chemi-mechanical pulp from poplar were similar to the groundwood pulp from spruce. The tear factor is higher than 30 at 4% alkali. However, one of the most objectionable affects of the Jet-alkali treatment was the reduction in the brightness. In this Jet-alkali process, when the alkali were added 2.5%, the brightness was reduced 2.1 units, but for the chemi-groundwood of poplar, the brightness was reduced 3.8 units, so the Jet-alkali process was much better.

The Jet-alkali groundwood can be used for paper-making without washing process. The PH of stock for making paper can be from 7.5 to 8.

The best conditions for the Jet-alkali process:
(a) Alkali charge about 2.8%, (b) Grinding consistency ranging from 2.5 to 3.5%, (c) Grinding temperture about 50 °C.

The breaking length can be increased 60-65%, the tear strength can be increased 20%, wet strength increased 20-30% in compared with common groundwood of poplar. The brightness of groundwood of white poplar was much better than groundwood of Cathay poplar. The strength properties of Jet-alkali groundwood from poplar with this process can be used to produce a pulp similar to groundwood of spruce for making newsprint.

Chemi-mechanical Pulping Group

1984.8.

Sulfonated Chemi-mechanical Pulping

— Summary —

Aspen and spruce chips having been treated with Na_2SO_3 solutions at PH from 7.4-10.2, total SO_2 concentrations from 2-6%, temperatures from 130-160 °C., and treating time 15-60 minutes, were refined in 300mm. KRK defibrator to produce sulfonated chemi-mechanical pulps(SCMP) which are used to replace all of sulfiteepulp in newsprint furnishes. The results show that increase the extent of the sulfonation is favourable for decreasing the specific energy consumed and for improving the physical properties of the pulp, but pulp yield and brightness are decreased. At a given sulfonate content(or total ion content for aspen)and gap between discs, the physical and optical properties of the pulp are substantially depending on the specific energy consumed. The refining conditions(such as gap between discs, pulp consistency etc.) are also the important factors for obtaining high quality pulps. The desirable sulfonating and refining conditions for aspen and spruce and their results are as follows:

	Aspen	Spruce
TA % (as SO_2)	4.0	4.0-5.0
Liq.to wood	3.85:1	4.30:1
Liq.PH	8-10	8-10
Treatment temp. C.	140	150-160
Treatment time min.	30	30
Yield %	91.3-92.2	92.5-93.5
Sulfonate content %	0.75-0.90	1.70-1.90
Total ion content m mole/100g	23-24	-
Brightness(ZBD) %	45.8-50.3	50-51
Gap between discs(Stage 1-2-3)mm.	1.5-0.03	1.5-0.1-0.03
Beating degree SR.	40-45	35-45
Pulp consistency(Stage 1-2-3) %	(14-16)-(20-25)	(14-16)-(20-25)-(20-25)

Total spec.energy consumed KWH/T	900-1000	1600-2000
Breaking length Km.	5.0-5.6	5.2-5.8
Burst index $KPam^2/g$	2.0-2.3	2.0-3.0
Tear index mNm^2/g	4.5-	5.5
Wet-web strength(Solid 11.5%) mN	450-500	639-922
Light scattering coef. Cm^2/g	300	280-350

when 66-67% and 71-73% waste liquor of aspen and spruce are reused on sulfonation, the chemical consumed are 126.8-130.7 and 148.7-153.9 Kg/T, BOD_5 discharges are 32.6 and 44.8 Kg/T, while COD are 156.0 and 125.2 Kg/T respectively for aspen and spruce, and the total solid(including organic and inorganic matter) of the spruce discharge is 227.6 Kg/T.

In comparasion with the newspaper made from 14% spruce SP and 86% SGW, the tear index for 25% spruce SCMP and 75% SGW is 20% higher, thus the wood will be saved 10.6%, and the wood cost is 10.5% lower. On the basis of equivalent physical properties, pulp furnishes of 21% spruce SCMP and 79% SGW or 7% spruce SCMP 12% aspen SCMP and 72% SGW, or 14% spruce SCMP, 14% aspen SCMP and 72% SGW can be used, the wood savings will be 8.2, 35.2 and 18%, and wood cost will be 11.1, 14.2 and 12.8% lower respectively. The brightness of these furnishes are 53-54%, the light scattering coefficient is decreased as the SGW furnish decreased. Bulk properties of papers are better, while surface strength and ink absorbility is a bit lower.

Note: SGW composed of 50% spruce SGW and 50% alkali spraying aspen SGW.

Sulfonated Chemi-mechanical Pulping Group

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