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CHEMI MECHANICAL PULPING AT HINDUSTAN NEWSPRINT

World's first Newsgrade successful Plant and An Ice-Breaker in tackling/taming Hardwoods:

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Abstract:

The author in this paper after describing Hindustan Newsprint (A subsidiary of Hindustan Paper Corporation — A Government of India's Enterprise) a prestigious newsprint mill and India's second, in brief with a capacity of 80,000 tpy, costing Rs. 157.8 crores and going into production in February end, 1982 initially with imported pulps-Chemical and Mechanical (TMP/CTMP/SGW) which were replaced by inmill produced pulps, further describes the chemi-mechanical pulping plants based on eucalyptus (grandis/hybrid) the heart of the newsprint mill with a capacity of 235 tpd and the various changes and modifications over years to make it run at the designed capacity meeting the newsprint machine's needs. Sulphuric Acid was used as an anti-chlor. It also details how pollution due to spent liquor- DKP press and also the spent liquor in soda recovery as against a part as recommended by our Consultants Sandwell, U.S.A. and for the latter by using an indigenously developed treatment involving use of alum, rare earths chloride and polyelectrolyte. Further given at a glance are the pulping conditions and properties of CMP and CMP flowsheet and the Raffinator segments used with their pattern.

Further recommends Cehmical Mechnical Pulping of shortfibred hardwoods— Plantation grown or virgin preferably the former with a view to raising new newsprint/printing paper mills for the developing countries for meeting the needs of the teeming millions for especially which are softwoods less/short and the developing countries too with a view to giving relief to their over-taxed slow-growing and fast-depeleting softwoods and especially when worldwide cellulosic raw materials crisis/famine has been predicted around 2000-2010 AD.

Introduction:

Hindustan Newsprint (earlier Kerala Newsprint— A subsidiary of Hindustan paper Corporation -HPC) is the second prestigious newsprint mill of the country and went into trial production February end, 1982 with imported pulps— Chemical and Mechanical and commissioned in November, 1982. It has a capacity of 80,000 tpy and cost Rs. 157.8 crores and was based on a newsprint furnish of 70:30 CSCMP: CP (CSCMP- Cold Soda Chemi Mechanical Pulp from eucalyptus grandis/hybrid and CP- Chemical pulp from Eta reed and lately from Bamboo and eucalyptus hybrid. At full production it will save our country precious foreign exchange to the tune of Rs. 56-57 crores. Newsprint production in the country is about 2.8-3.0 lakh tons (20,000 tons being supplied by Rayalaseema Papers) and the demand is about 5.9 lakh tons for 1987-88 as estimated by Registrar of Newspapers, India. Balance requirements of newsprint are imported from various countries and entail an expenditure of about Rs. 120-140 crores annually, disturbing the balance of payments (BOP) of the country.

Chemi Mechanical Pulping (CMP) - Cold Soda

Eucalypt (grandis/hybrid— — all plantation grown after being chipped in KMW-Sweden chippers is stored in different silos and the chips extracted via respective parascrews, whose speeds can be varied to have a design mix ratio 70:30 or 80:20 eucalyptus grandis: hybrid. And are conveyed via the belt conveyor to the chemi mechanical pulping plant (CMP). After passing through the weightometer and also magnetic pulley go to chip washer wherein all the sand dust foreign materials/contraries are removed and the washed chips sent to presteamer/deaerator where they are pre-heated to a temperature of about 82°C using steam— LP whereby they get deaerated and which helps in better penetration of chemicals as well as better strength development. The heated chips are further fed into the PREX (PRessure EXpansion) vertical impregnation system through a ADI screw 13½" where NaOH at 60-62 gpl concentration enters from the bottom and a constant liquor level about 90% is maintained always, the

chips thereby expand and absorb NaOH like a sponge with a chemical uptake of 5.5 -5.6% and even 6% sometimes (on O.D. chips basis) In a 15-20 minutes of retention time. During the pressing in the screw a considerable amount of liquor is expressed out and this helps to reduce the amount of alkali required for impregnation. The height of the impregnator is about 13.78 m and vertical lift screw in the PREX lifts the chips up where they are continuously scraped from the top of the vessel into a discharger screw, then go into a buffer vessel where they get a retention time of about 5 minutes depending on the level and which helps in the strength development to a small extent. The continuous impregnation system has an edge over the old/conventional chip bin and batch system in ayoiding the considerable brightness loss due to the oxidation of polyphenolic substances with atmospheric oxygen.

The treated chips are discharged by the vibra discharger into the twin screw feeder and screw press (type S 17"F) where excess liquor is squeezed out alongwith fines and sent to DSM screen with recovered fines joining impregnated chis going into Raffinator No.1 and spent liquor used partly for flushing of the screw press and partly in impregnation liquor preparation. Provision is also there to bypass the buffer vessel and screw press.

Nucleonic gauges-based chip level control system has been provided for controlling the retention period both in the deaerator and the buffer vessel.

All the three Asplund Raffinator RL 585 are now equipped with 58- in discs (single disc rotating earlier were only 54-in) and powered by 6500 KW motor/1500 rpm ech supplied by BHEL, India) and are non-pressurised. The rotating disc can be run in either direction and we reverse the direction after every 700 hrs. run so as to get increased life out of the Refiner discs which are imported costly and supplied by Sunds/Defibrator from Hagfors Malsegment AB (New company formed by Sunds Defibrator and Uddeholm castings sometimes back.) Refinery plate/disc life has been almost doubled/trebbled in case of 58-in for Raffinator No. 2 and 3 and for Raffinator No. 1 a record of 6036 hours for 58-in disc beating the earlier record of 4242 hrs has been achieved thereby reducing the cost of pulp manufacture greatly as well as the down-time associated with the disc change.

The squeezed chips from the screw press are fed to the Raffinator No. 1 at a consistency of 47-50% for refining and the discharged pulp is diluted to a consistency of 18-20% at a freeness of about 700 ml. csf and fed via a high density pump to the DKP Press where liquor is further pressed with pulp getting a little defibration and then fed to the Raffinator No. 2 (similar to Raffinator No. 1) at a consistency of about 24-25% and with out-going freeness of 500-520 ml csf then goes into a latency chest and from where sent to the unbleach washer for washing i.e. removing the coloured matter.

The washed unbleach pulp at a consistency of about 10% goes via a chemical mixer (Hindustan Dorr Oliver) where calcium hypochlorite and caustic soda (as buffer) are added into the downflow tower No. 1 where consistency is about 7-7.5%. The bleached pulp at the bottom after balance calcium hypochlorite and caustic soda added is then pumped to the bleach tower No. 2 and the consistency is about 4% and the tower being upflow. Bleached pulp overflows from the tower No. 2 onto bleach washer through launder whereafter being washed is sent to the Raffinator No. 3 (similar to Raffinators No. 1 & 2) where it is refined alongwith the rejects (rejected from the pressure screen and tertiary cleaners accepts thickened to a consistency of 10-11%) at a consistency of about 11-12% and freeness of 350-380 ml csf and then screened using Tampela (Finland) pressure screen having performation diameter of 1.6 mm and 4 stage centrifugal cleaners and then the pulp thickened finally on one disc filter (Hindustan Dorr Oliver) we have two before being sent to the high density tower having a day's production storage capacity. The pH during the three refining stages is about 8.8, 8.5 and 7.3 respectively. the brightness of the pulp is maintained in the range of 49-50°E. Hydrogen peroxide a luxury for us in paper industry is not used for bleaching because of its exorbitantly high cost. Though it is lignin preserving as against sodium hypochlorite which is ligning destroying.

Sulphuric acid is added at the rate of 15-17 kg/ton of pulp after being diluted, to the pulp to give advantages at pulp stage:

* Neutralising the residual alkali
* Reducing the Ferric (Fe +++) to Ferrous (Fe ++) improving the brightness.
* Avoiding brightness reversion
* and improving brightness and brightness stability.

We are having all stainless steel 304 piping and SS 316 other equipments in CMP Plants as well as paper machine so as to avoid discoloration of pulp due to iron (Fe) and copper (Cu) and especially Fe coming from the wood and the other contaminating sources and other metal ions which form complexes with tannins/polyphenols, Ferric compounds compared to ferrous compounds are more highly colored at paper making stage:

— Increased drainage at the wires (our Paper Machine being a Duoformer- Voith J.M. GmbH, Germany (Fed. Rep.).
— Cleaner felts
— Increased drainage at the presses
— Lesser steam consumption for drying, and lower costs.

- Lesser slime problem
- Cleaner wet end system for extended periods.
- Lesser (almost half) alum consumption 26-30 kg/ton of newsprint from earlier of 65-70 kg./ton (which is more costly than sulphuric acid) and again lower costs.
- Improved/upgraded profitability. A big welcome in these days of skyrocketing trends in prices of all inputs from A to Z.

In order to offset the yellow cast in CMP characteristic of hypochlorite bleaching methyl violet is used at the paper making stage.

The design capacity of the CSCMP plant is 235 tpd and the peak 264 tpd bleached pulp. All-out efforts have been made and are being made constantly to replace the imported mechanical pulps which are not only costly but also entail foreign eschange expenditure/drainage. Highest production attained till now is 255 tons on September, 1, 1985 and latter as high as 250 tons on May 13, 1986. Highest monthly production again till now is 5342 tons in March 1986 beating the earlier record of 5137 tons in December, 1985.

Lut filter- a big help for filtering DKP Press liquor.

A new Lut filter supplied by Sunds Defibrator had been installed in April 1986 and is being used for filtering the spent liquor- DKP press thereby allowing continuous/smoother high capacity operation of the chemical pulp plant and its wirecloth 60 mesh as originally supplied was changed with 100 mesh to as not to be allowing fibre fines along the liquor and fouling the evaporator tubes. The filtered liquor is sent to the weak liquor tank in the chemical pulp mill from where it goes alongwith the kraft black liquor to the Malone filter undergoing thereby double filtration before going to soda recovery. Provision is also there to send the CMP spent liquor directly to soda recovery. The pulp fines got from the spent liquor are added to raffinator No. 2 feed.

Various changes and modifications

- Modifying chip washing system.
- Steam pipe support system in Deaerator
- Increasing vertical lift screw in PREX impregnator speed to 42 rpm from 30 rpm.
- Increasing ADI 13½— speed to 130 rpm from 94 rpm.
- Increasing DPK press speed to 15 rpm from earlier 11 rpm.
- Changing over to 58-in. segments in all the Raffinators from 54 inches.
- Providing bypass for No. 3 and 2 Raffinators.
- Providing additional venting (No. 1 Raffinator)

- Shifting DSM screen from Raffinator floor to DKP press floor
- Modifying conical portion of the Buffer Vessel.
- Replacing the hollow screw press with solid screw press to avoid shearing
- Providing air nozzles for discharge of pulp cake from the thickner sectors.
- Utilising DKP Press liquor for dilution at Raffinator No. 1 instead of unbleached washer filtrate.
- Removing the couch roll system provided at the washers
- Unbleach and bleach and providing wooden doctors.
- Providing better and more support for high density line to DKP press developing cracks every time.
- Changing over the valve position from the delivery of centricleaner cones to the accept header for avoiding bursting of the fleible hose pipe.
- Resorting to the usage of Sulphuric acid.
- Utilising white liquor in place of caustic soda for impregnation.

Table No. 1 gives at a glance the pulping conditions in CMP
Table No. 2 gives the pulp properties.

CSCMP Spent Liquor- Utilisation-Disposal a big headache but well tamed:

CSCMP spent liquor is brown in colour and low in solids i.e. 2.5-3.0% and 235 ltrs./lpm were to be sent to the drain and 165 lpm to soda recovery for evaporation. Drainage of this liquor to the effluent created a lot of problem- hullabaloo from the population downstream and lot of protests and dharnas and ways and means had to be developed to process the liquor in full rather than a part as advised by our Project Consultants — Sandwell U.S.A. Evaporation of the liquor in soda recovery after filtering in Lut filter and malonefilter entails a recurring cost of about Rs. 60-70 lakhs annually. Efforts are under way to find a cheaper method to treat this liquor for a concentration of 10-11°Tw before sending into the evaporators by applying membrance technology using "ultrafiltration.

The unbleach washer filtrate is also coloured and is partly used for pulp dilution and rest is sent to the effluent for which the mill had to resort to a indigenously developed process consisting of alum, rare earths chloride and polyelectrolyte (synthetic charged polymeric material) whereby the colour bearing particles and also the biodegradable organic compounds get precipitated and all this happening at ambient temperatures with colour being reduced to 120 to 140 Pt. co. unit from 5,000 - 6000 Pt co. after CMP effluent at a colour value of 12-13000 Pt. Co. mixes with the other streams.

the treated effluent being led into the river meets the stringent standards/regulations of the Indian Standards Institution (ISI) now Bureau of Indian Standards and Kerala State Board for Water Pollution Prevention. This treatment costs a recurring expenditure of Rs. 60 lakhs annually. Various other treatments such as lime (not successful because of difficulty of handling large amounts of sludge) alum, sand, and boiler ash have been suggested and used from time to time with some degree of success, but with lot of problems such as high costs, etc.etc. and the latest addition is bacteria.

Chemi Mechanical Pulphas special importance when used for newsprint manufacture and especially when or more so when it is from short fibred hardwood plantation grown.

CMP should have:

-—Maximum/best or highest possible strength thereby decreasing the percentage of Chemical Pulp- Long fibres (percentage depending upon the paper machine speed) and governing the every economics of newsprint manufacture leading to highest possible production and profitable operation on overall basis and also maximum and highest possible optical characteristics (opacity/light scattering coefficient) providing the optimum printability avoiding showthrough, print through and subsequent readers complaints and is of prime importance for the printers, publishers and advertisers.

Ratio of CMP:- CP as envisaged by Hindustan paper Corporation during the feasibility studies and even later was 70:30, revised to 65:35 by Sandwell while making detailed project report fearing that eucalyptus may not develop desired strength but we have achieved a ratio of 78:22 or even 80:20 which is a great achievement and speaks volumes about our pulp CMP and CP as well quality-wise and also for the great success of our chemi mechanical pulping process for taming short fibred hardwoods the hard to crack nuts utilising Sunds Defibrator plant/machinery

-— Chip washing, deaeration, impregnation, screw press, DKP pres and the Asplund Raffinators

-— the heart and soul of CMP which after teething troubles, customary in the beginning have all worked well and given and giving excellent pulp and fine/beyond expectation results even inspite of utilising both eucalyptus grandis and hybrid and the later having quite high density.

The stronger CMP has not given only a stronger newsprint sheet but also good/improved runnability at the speeds at 630-640 m/min and newsprint production as high as 338 tons had been achieved on August 27, 1985 and a highest monthly production of 8033 tons had been atained in March, 1987 (imported pulp content 892 tons) and 7495 tons in December, 1985 (imported pulp content 174 tons).

Hindustan Newsprint —-
A Torch Bearer for Developing Countries:

Hindustan Newsprint- HNL is to-day one of the biggest newsprint mill in Asia and premier Government of India's Newsprint Mill in Public Sector —

-—Mill in Public Sector-

-—Making newspring from a Tropical hardwood- Eucalyptus (grandis/hybrid).

-—Employing chemi mechanical pulping (CMP) —Cold soda process for taming short fibred hardwood the hard to crack nut and the headache employing Sunds Defibrator, Sweden plant/Machinery and producing excellent quality pulp better than spruce groundwood.

-—Using as high as 75-78% CMP in newsprint scoring again as the world's first as never in the history of newsprint manufacture such a high per centage of CMP (CS) ever been used (max. being 22 to 23%) for fear of show through, print-through as any ligno-cellulose fibres when treated with alkali however mild that treatment be, makes it lose its opacity which is very characteristic and a must for newspring/printing papers.

-—Making newsprint maching very well international standards and beating all other Indian newsprint.

-—Using a new, novel, rather revolutionary process for tackling the colour problem from the CMP effluent which has hindered the growth of Chemi Mechanical Puling of hardwoods and coming up of newsprint mills. In the developing countries and more so in those which are softwood less or short or hardwoods rich or cangrow hardwoods light density, light colour 7-8 years rotation cycle and plan a newspring mill and Hindustan Newsprint serving as a showpiece and a model to follow.

-—Taking very good care of protecting the natural environment and avoiding ecological damage.

Conclusion:

In conclusion the author would say that Chemi Mechanical Pulping at Hindustan Newsprint should serve as a Torch bearer and a model to follow suit for those countries interested in raising newsprint/printing paper mills, saving foreign exchange running to millions of dollars/rupees annually disturbing their balance of payment especially for the developing countries which are softwood less but having plenty of hardwoods or for those which would like to raise even plantation hardwoods light density, light colour as the young hard-woods are said to be giving the best of cold soda chemi mechanical pulps, requiring less of even bleaching and pulping chemicals or even for the developed/industrilised ones with a view to giving respite to their slow-growing and over-taxed softwoods which have a growth cycle of 70-90 years as against 20-25 years for pine and 7-10 years for hardwoods.

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Pulping conditions at a glance — TABLE 1.

Wood species used	— Eucalyptus grandis /hybrid
Chip washing Temperature/Pre-steaming	— 75 — 80°C/ — 85°C.
Steam consumption (for pre-steaming)	— about 200 kg./ton pulp
Impregnation liquor Temp./Concentration	— 60 - 65°C/60 - 62gpl as NaOH
Caustic Soda used for impregnation	— 5.5 - 6% (on O.O.Chips)
Quantity of Spent Liquor	— 2.1 - 2.4 m^3/ton Pulp

Refining

Raffinator	Consistency	Freeness (ml. CSF)
No. 1	48 - 50	650 - 700
No. 2	24 - 25	470 - 500
No. 3	11.5 - 12	380 - 400

Power consumption for refining only : 1150— 1250*
Total power consumption : 1450 - 1500* KWH/T

Bleaching :

Chlorine (as hypochlorite)	— 10 - 12% (as against norm of 15 - 16%)
Caustic Soda (as Buffer)	— 1 - 1.2 %

Bleaching Stage	pH	Consistensy%	Temperature °C
I	10.5-11	6-7	39-40
II	9-9.5	4-4.2	37-38

Sulphuric Acid used (as anti-color) - 15 - 17kg./ton pulp
Water consumption — 34 - 35 m^3/ton pulp
Pulp Yield (Bleach) — 82 - 83

Refining Consistency in Raffinator No. 2 & No. 3 has been increased to 24 and 11.5-12 and sometimes even 12.5 so as to improvethe pulp quality and HCR has an edge over LCR.

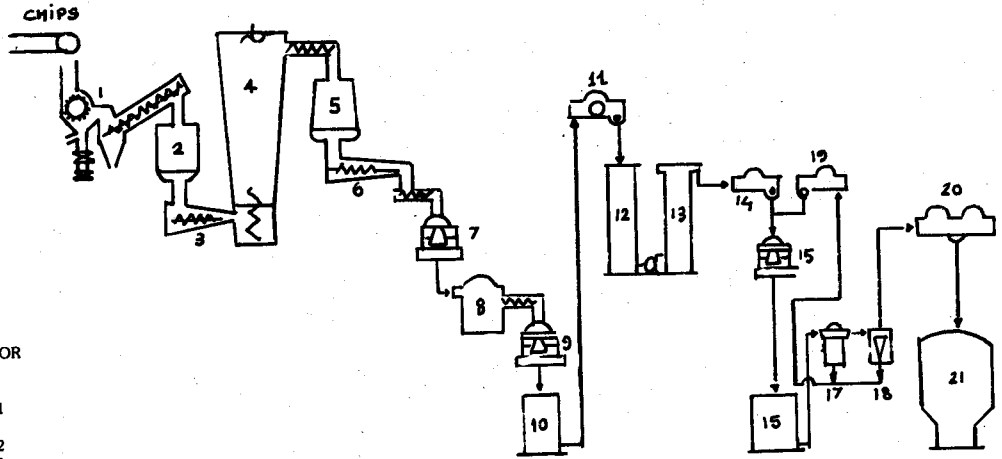
TABLE 2.

Chemi-Mechanical Pulp-Properties

pH	— 5.5 -- 6.0
Freeness	— 210 -- 240 ml. CSF
Burst Factor	— 14 -- 16
Bulk	— 2.1 -- 2.3 Cm^3/g
breaking length	— 2800 -- 3200 m
Tear Factor	— 38 -- 42
Wet Web strength	— 37.4 -- 42.5 N/M or 110-125 g/30mm
Folding Endurance (DF)	— 2 -- 3
Porosity (Bendstsen)	— 2100 --2300 ml/min
Opacity (Printing)	— 88 - 91%
Yellowness	— 36 - 38%
Light scattering co-efficient	— 48-50 m^2/kg (as against 65-70m^2/kg for stone ground-wood)
Light absorption co-efficient	— 2.8 -- 3 m^2/kg.
Brightness	— 49 -- 50°C.
Strech	— 1.4 -- 1.6%
Shive content **	— 0.01 - 0.02% (as compared to 0.15% in spruce TMP & 0.04% in CTMP)
**(Somerville 0.15 mm Slot)	— (Shive content in C.M.P.is exceptionally — low indicating complete/even penetrationof chips with alkali)
Ash	— 1.4 -- 1.6%

Fibre classification (Bauer Mcnett)

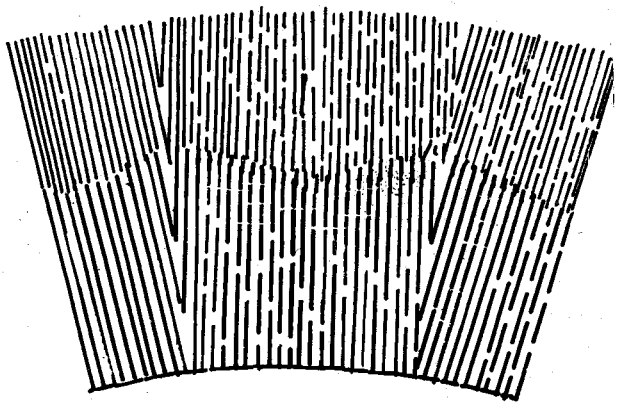
+ 30	2.9%
— 30 + 50	35.9%
— 50 + 100	25.6
— 100 + 200	9.2%
200	26.4%



1. CHIP WASHER
2. PRE STEAMER
3. ADI SCREW
4. PREX IMPREGNATOR
5. BUFFER VESSEL
6. SCREW PRESS
7. RAFFINATOR NO.1
8. DKP PRESS
9. RAFFINATOR NO.2
10. LATENCY CHEST
11. UNBLEACH WASHER
12. BLEACH TOWER NO. 1
13. BLEACH TOWER NO. 2
14. BLEACH WASHER
15. RAFFINATOR NO. 3
16. PULP CHEST
17. PRESSURE SCREEN
18. CENTRI CLEANERS (4 STAGE)
19. REJECTS FILTER
20. DISC FILTERS
21. HIGH DENSITY TOWER

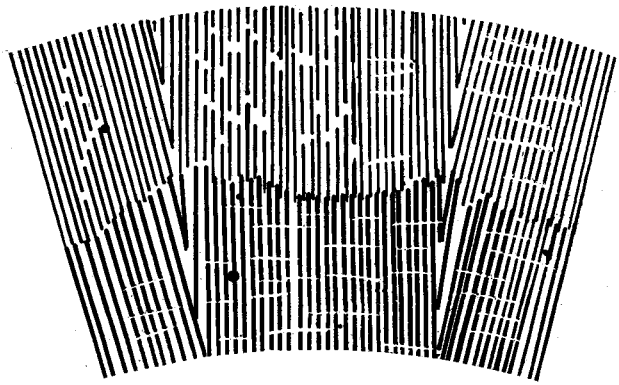
SCHEMATIC DIGRAM OF CMP PLANT

Plate/segment pattern for Raffinators R:-58 S



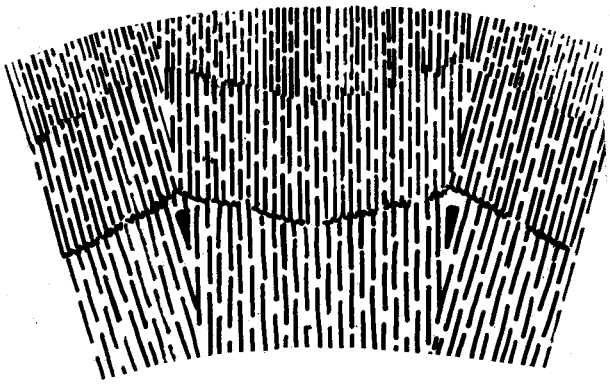
Raffinator No. 1
Segment
P 15242

Rotor and Statar : Outer



Raffinator No. II
Segment
P 15289

Rotor & Stator : Outer



Raffinator No. III
Segment
P 15246

Rotor and Stator : Outer

Raffinators I, II and III
Segment - C 13903

Inner segments dia. 1014 mm (40 in)
(8 setments in one rotating or stationary ring)

Outer segments dia 1473 mm (58 in)
(12 Segments in one rotating or stationary ring)