# Deinking for Newsprint Manufacture

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The demand for Newsprint in our country is expected to reach a level of 9.5 — 10 lakh tonnes by 2000 AD. With the depleting forest based raw materials, manufactuers of Newsprint and Fine Papers are already on the look out for unconventional raw materials. The need to regenerate secondary fibres to such an extent that the original fibre stock is reclaimed for the manufacture of qualitatively equivalent products, has triggered the development of DEINKING processess which have found wide industrial application over the past 20 years. It has already gained high popularity in Japan and Western Europe. In our country, the importance is gaining momentum, with the liberalisation of import of Waste Paper accelarating the pace of Deinking technology.

Though the demand for newsprint is realised by the Paper Industry, Entrepreneurs in this field are reluctant to setting up of newsprint projects, due to the prohibitively high capital investment cost of a newsprint mill, which operates on Virgin pulp. Figures indicate that the approximate project outlay of a newsprint project based on deinking of secondary fibre is around 40—50% (if not less), of what would have been for an integrated pulp and paper mill based on Virgin fibre. Besides the low capital investment, deinking of printed secondary fibres offers the following advantages :

- Energy savings to the extent of 50—60%.
- Negligible load on the paper mill effluent treatment plant and therefore, environmental protection.
- Specific BOD 5 load 33 kg/tonne for flotation.
- Low fresh water consumption 7—15 $m^3$/tonne depending on production. With closed efficient back water circuit, the make up fresh water can be as low as 3—5 $m^3$/tonne.
- Very low steam requirement range 0.2 to 0.5 tonne/tonne.

The development of modern printing inks. their formulation and printing technology have increased rapidly in recent times. Of the two basic processes for deinking i.e., washing & flotation, the world wide predominance of flotation deinking can be gauged from its share of 70% of the total deinking capacity. Newsprint dominates the grade structure to the time of 65% of the total flotation deinking because of :

- higher yield, 93% as compared to 85% by pure washing ;
- lower chemical cost per tonne of finished product, refer annexure tables ;
- easier closing of water circuit ;
- half the BOD load ;
- less sensitive to ink particle size ;
- offer ideal paper surface/structure to suit offset printing.

From the table enclosed, it will be observed that the difference in cost of chemicals represent an annual extra expense of about 1,17000 US dollars per year with pure washing process. In addition, the cost of chemicals of flotation indicated in the table is further reduced by 25% in Japan & Western Europe by adopting high consistency deinking method explained subsequently.

Voith developed the flotation deinking system in the year 1956 & since then more than 65% of all deinking systems bear their trade mark. There are 124 systems with a daily production capacity totalling above 8000 tonnes, in operation worldwide.

## DEVELOPMENT IN FLOTATION DEINKING PROCESSES :

Keeping in mind the type of waste paper, quality of printing inks and the nature of contaminants present, different processes have been

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adopted for preparation and prescreening of printed secondary fibre prior to entering the flotation machine.

I. Conventional method with vertical batch type pulpers.

II. Contitnuous slushing followed by High Consistency Deinking.

III. High Consistency Slushing, followed by High Consistency Deinking.

The above methods, with the relative operating experience and merits have been elaborated in the annexures. However, with these basics, further tailor made systems are possible depending on the grades of waste paper.

## THE HEART OF THE SYSTEM — THE FLOTATION MACHINE :

In late fifties Voith pioneered in manufacturing flotation deinking equipment using an open rectangular cell design. Over the years, the basic concept was maintained, but continuous improvements were carried out with primary objectives in savings in energy, increase in deinking officiency, operational reliability and no environmental polution. This resulted in the development of TUBULAR flotation cells with INJECTORS.

The cross sectional view of this newly developed TUBULAR FLOTATION CELLS with INJECTOR is shown in enclosed annexure — sketches. The flotation cells are connected in series. The stock suspension is drawn by a centrifugal pump with a special impeller and delivered into the Injector extending into the cell vertically from above. The Injecor is designed and dimensioned so that the air is drawn in freely above the level of stock suspension without any additional device.

It is evident from the *enclosed table*, showing comparison of Voith Flotation Cells that the new tubular cells with Injector has reduced the power requirement per cell from 18 to 12 kw by 33%.

## I. CONVENTIONAL DEINKING SYSTEM—SLUSHING, PRESCREENING AND DEINKING

During late fifties the availability of sorted grades of waste paper was abundant. The waste papers were also relatively free from plastic contaminents. The formulation of ink and the printing process enabled easy removal with the following process and equipment which could meet the demands of the end users.

| Process sequence | Device/Voith equipment | Process parameters | Operating experience/ Remarks |
|---|---|---|---|
| **Batch Slushing** | Vertical Pulpers | 5—7% cons. waste Papers Chemicals Water Steam—40—60°C | — Standard process that prevailed in late fifties. |
| Chemical Reaction Retention | —do— In holding chest | — Retention 60—90 min at 4—4.5% cons. | — I deal for Sorted Waste Paper grades with limited Heavy and light weight contaminants. |
| Contaminants/contraries elimination. Heavy contaminants | High consistency Purifiers. | Cons. 3.5—4.5% | — Affected operational reliability and maintenance with increased contaminants. |
| Light weight contaminants. | Vibration Screens | —do— | — Less separation efficiency of contaminants and higher fibre loss. |
| Mechanical Impact | Double Disc Deflaker. | —do— | |
| Deinking | Flotation Cells of rectangular design with rotor. | Cons. 0.8-1.2% Hardness 180-220 ppm Flotation time approx. 10 min. | |

## II. ATS—N HIGH CONSISTENCY DEINKING SYSTEM

In seventies the availability of sorted grades became scarce and the mixed grades carried high amount of heavy as well as light and ultralight contraries. Moreover, the rapid developments in printing technology also necessitated to evoke better systems to take care of hard to deink grades of waste paper, keeping economy and wider applications of deinked stock. This led to high consistency deinking process described in the following table :

| Process Concept | Device/Voith Eqpt. | Process Parameters | Operating Experience/Remarks |
|---|---|---|---|
| Continuous Slushing | Horizontal Pulpers with Ragger. | Waste Paper Chemicals Water Cons. 4—4.5% | * Units in operation since late seventies. |
| Chemical Reaction I | Partial in Pulper | — | * Fully continuous operation of the entire plant, consequent reduction of operating & supervisory personnel. |
| Contraries Elimination | | | * Substantially more efficient separation of light weight contraries & heavy dirt particles. |
| —Ultra heavy/ heavy & light weight | Pulper Dirt Trap Turbo Separator ATS-N Cleaner Vibration Screens as tailing screen to Turbo Separator. | Cons. Around 4% | * Saving in steam on heating in high consistency range, only about 25% of the required amounts of water to be heated up. |
| —Ultra light | 2nd stage Turbo Separator with fine perforation having sortex /vibration screen as tailing screens. | —do— | * Exact metering of chemicals in the double shaft mixer. |
| High Consistency treatment. | | | * Increase in brightness upto 4 points with same quality of chemicals. Chemicals cost saving upto 25%. Deinked stock cleaner & homogeneuous. |
| —Dewatering | Belt Thickener | Cons. from 4-4.5% to 23% | Payback period within 2 years due to chemical & steam savings. |
| —Blending of Chemicals | Double Shaft Mixer | Chemicals Steam 45-50°C | * No. plastification of stickies due to slushing at low temperature. |
| Chemical Reaction II | Reaction Tower | Reaction time 3—4 hrs. | |
| Mechanical Impact | Double Disc Deflaker (Not required for coated, woodfree grades). | Cons. 4—4.5% | |
| Deinking | Flotation cells of Tubular design with rotor. | Cons. 1—1,5% Hardnaess 180—220 ppm Flottion time approx. 10 mts. | |

## III. MODERN DEINKING SYSTEM AT HIGH CONSISTENCIES

In addition to the difficult to deink grades of waste paper, the changing environment in the converting operations, along with innovations in the adhesives and glue industries have further thrown a challenge to eliminate ultralight contaminants & stickies such as hot melts, pressure sensitive adhesives, styrofoam and latices from the waste paper. The modern deinking system, as detailed below takes care of the above with least space & energy consumption :

| | | | |
|---|---|---|---|
| Batch Slushing | HD Pulper | Waste Paper, chemical, Water, Cons. 12—18%. | Permits further optimisation of ATSN High Consistency deinking method. |
| Chemical reaction I | Partially in Pulper | —do— | Stickies remain large & not plastified during slushing at 12—18% and can be removed by screen drum & following units. |
| Contraries Elimination — Heavy, light & ultra light wt. | Pulper, contaminex, Screen Drum, Turbo Separator with perfn. Vib. Screen/Sortex as Tailing Screens. | Cons. 12—18% & 4% | Ideal for offset printed waste due high consistency slushing with special low speed rotor. |
| — Stickies | Pulper<br>Turobo Sorter with slots | Cons. 12—18%<br>Cons. 4—4.5% | Space economy offered by Pulper. |
| HC Treatment & Mechanical Impact. | Same as Case II | Same as Case II | Lower overall specific energy requirement. |
| Deinking | Tubular flotation Cells with Injectors | Cons. 1—1.5%<br>Hardness 180—220 ppm<br>Flotation time approx. 7 mts. | Apart from above other advantages as mentioned in Case II also applicable. |

## ANNEXURE—TABLES

| Chemicals | Flotation (7% loss) containing groundwood % | $/t | woodfree % | $/t | Washing (15% loss) containing groundwood % | $/t | woodfree % | $/t |
|---|---|---|---|---|---|---|---|---|
| NaOH | 1.5 | 2.73 | 2.0 | 3.64 | 1.5 | 2 93 | 2.0 | 3.91 |
| $H_2O_2$ | 0.8 | 6 68 | — | | 0 8 | 7.18 | — | |
| Na-Silicate | 3.0 | 7.06 | — | | 3.0 | 7.59 | — | |
| Sequestrant | 0.2 | 3.06 | — | | 0.2 | 3.29 | — | |
| Deinking Chemical (e.g. Soap Detergent) | 1.0 | 10.17 | 1.0 | 10 17 | 1.2 | 10.41 | 1.2 | 10.41 |
| Flocculant | — | | — | | 1 2* | 0.45 | 1.2* | 0.45 |
| Alum | — | | — | | 1 4 | 1.75 | 1 4 | 1.75 |
| Total Cost $/t | 29.70 | | 13.81 | | 33 60 | | 16.52 | |

*Reterred to solids content in filtrate.
*Deinking chemicals (costs published in "Chemical Marketing Reporter", Jan. 21, 1980).

TABLE–1 Conditions of laboratory test with offset-printed dailies (wastepaper and use of chemicals)

| | |
|---|---|
| Wastepaper furnish: | 65% dailies, Offset-printed |
| | 3—6 months old |
| | 35% magazines |
| Addition of chemicals: | 2.0% NaOH (100%) |
| | 1 0% $H_2O_2$ ( 00%) |
| | 3.0% sodium silicate (37°Be) |
| | 0.3% complex-forming substance (DTPA) (chelating agent) |
| | 1.5% soap |

TABLE–3 Conditions of large-scale laboratory test with offset-printed dailies (Comparision of the two systems)

| | |
|---|---|
| Waste paper furnish: | 80% dailies, offset-printed |
| | 3–6 months old |
| | 20% magazines |
| Addition of chemicals: | 1,5% NaOH (100%) |
| | 0.7% $H_2O_2$ (100%) |
| | 2.5% sodium silicate (37·84) |
| | 1.0% soap |
| | 0.06% dispersing agent |

TABLE–2 Results of laboratory test with offset-printed dailies (comparison of the two systems)

| | Brightness (%) Elrepho F 8=457 nm $BaSO_4$=100% | Whiteness (%) Elrepho F 10=FMy/C $BaSO_4$=100% |
|---|---|---|
| Admixture of wastepapers. slushed in cold condition without the addition of chemicals | 43.9 | 46,3 |
| Specimen sheet of the blank trimmings of the mixture of wastepaper | 59.8 | 66.6 |
| Finished stock deinked according to the standard method | 59.5 | 66.6 |
| Finished stock deinked according to the ATS-N HC method | 63.7 | 73.0 |

TABLE—4 Results of large-scale laboratory test with offset printed dailies (comparison of the two systems)

| | Brightness (%) Elrepho F8=457 nm $BaSO_4$=100% | Whiteness (%) Elrepho F 10=FMY/C $BaSO_4$=100% |
|---|---|---|
| Admixture of waste papers slushed in cold condition the addition of chemicals | 40.3 | 41.7 |
| Specimen sheet of the blank trimmings of the mixture of waste paper | 57.1 | 63.8 |
| Finished stock deinked according to the standard method | 57.1 | 65.4 |
| Finished stock deinked according to the ATS N HC method | 57.8 | 66.2 |

Thus the TUBULAR CELLS with INJECTOR offer the following distinct advantages :

* Closed constrution, outdoor installation possible — flotation unaffected by weather.
* No additional units such as blower fans or co.npressors required, as Injectors operate on principle of self priming.
* Non—clogging injectors due to large nozzle cross section ; injectors located above the liquid level, therefore, no risk of plugging even with frequent shut downs.
* Extremely high rate of air flow thus substantial improvement of the flotation effect and reduction of flotation time and number of cells.
* Fine adhesives and stickies eliminated in addition to ink, such elimination not possible in other design.
* Maximum brightness by means of multiple forced air injection.
* Excellent cleaning effect due to large floatation volume and high supply of air.

FINE SCRFENING & CLEANING :

Fine screening & cleaning at low consistencies is indispensable to enhance the cleanliness of the stock. Some of the fine contaminants, even effect the smooth runnability of high speed newsprint machines, more particularly the stickies, in a twin wire former. Modern trends in this line are to incorporate,

— 3 or 4 stage full flow forward cleaning system with deaeration ;
— Reverse Cleaning System ;
— Multistage pressure screens with fine perforation followed by tailing screens;
— Multistage pressure screens with fine slots to the extent of 0.2 to 0.25 mm in primary & tailing screens.

The enclosed flow diagrams (annexure-sketches) show the arrangement & their location for different combinations and the systems adopted.

BLEACHING :

Deinked stock, depending on the composition of secondary fibres contain more or less coloured material. The resultant tint can be eliminated by subsequent bleaching. Increase in brightness including tint removal can be obtained by adopting suitable bleaching agents and techniques, without need for any washing.

HOMOGENISATION WITH DISPERSION OF DEINKED STOCK :

The offset printed dailies especially after several weeks of storage are generally very difficult or impossible to deink. This is mainly attributable to the binders used with these printing inks, such as alkyd resins, linseed oil, etc., which enter into irreversible cross linking reactions under the influence of atmospheric oxygen,

For the above and other special printing inks which adhere tenaciously to the fibres, it will be inevitable in several countries to disperse the traces of non-separable printing inks below the limit of perceptibility. For this purpose, after dewatering the stock to a consistency of 25% in a belt Thicknener, dispersion is carried out in a Kneader or Disc Dispersion Unit.

DEASHING :

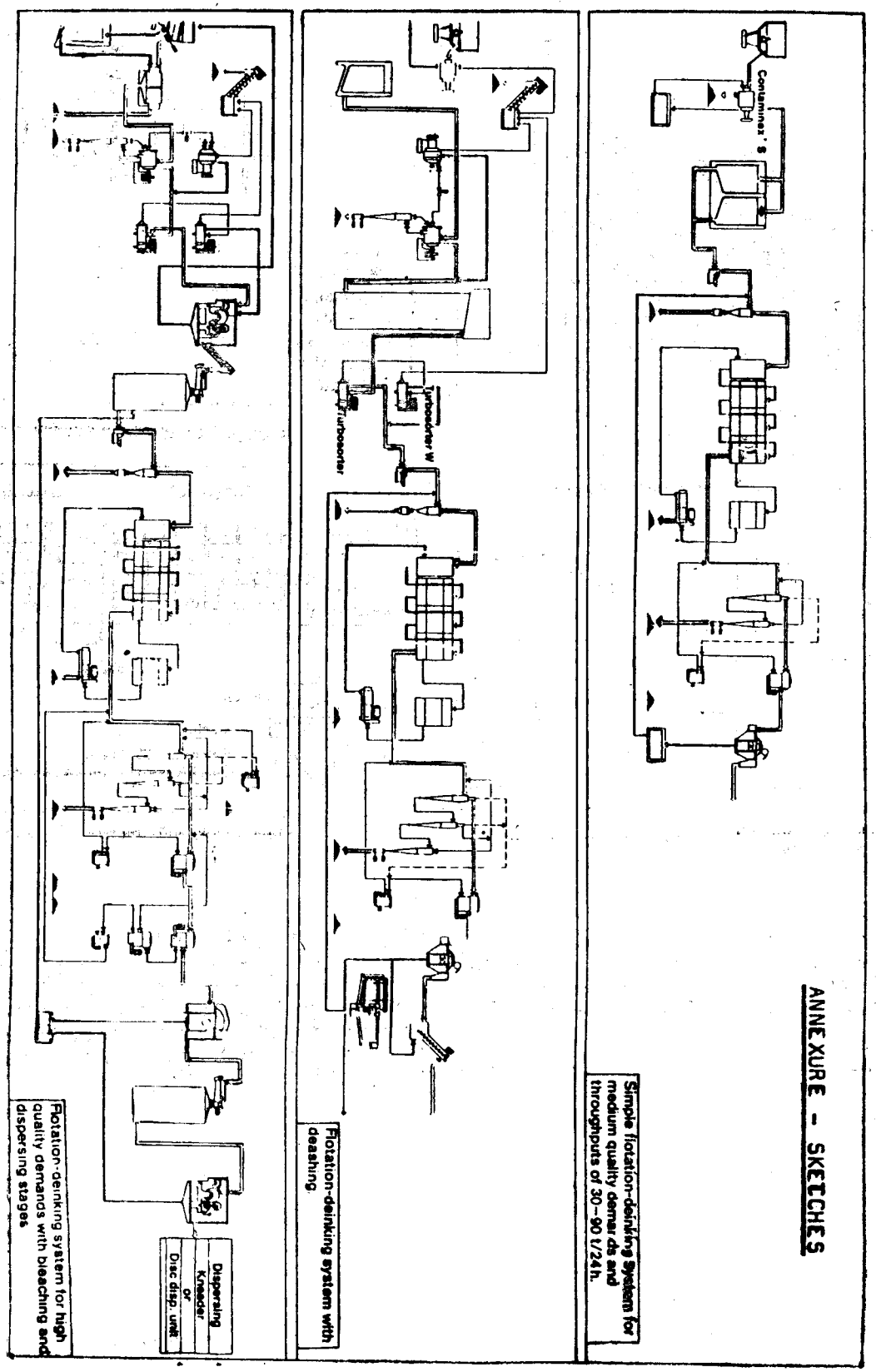
The fibres used for the production of paper such as, soft tissue must be virtually ash free. The separation of fillers by the Flotation Process is greatly dependent on the particle size. Coarse fillers are normally discharged along with the froth upto 30% ; fine fillers, as used for costing upto 80%.

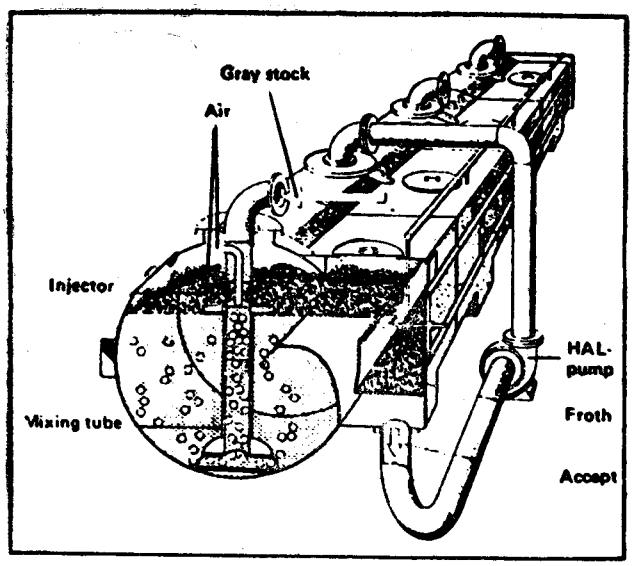
For the removal of ash, it is necessary to modify the flotation deinking process so that the filtrate of the thickener for the deinked finished stock is not returned to the circuit but treated by allowing to settle in a clarifier. The clarified filtrate is then returned to the circuit of the flotation deinking plant, maintaining the advantages of the closed system.

The enrichment of the thickener filtrate with fillers and fines can be intensified by feeding the thickener by means of a slice. With a very high content of the secondary fibre feed, an additional dewatering (deashing) stage — Drainator—may be required. Also the filtrate of this stage may be partly or totally treated in the sedimentation clarifier and returned to the circuit.

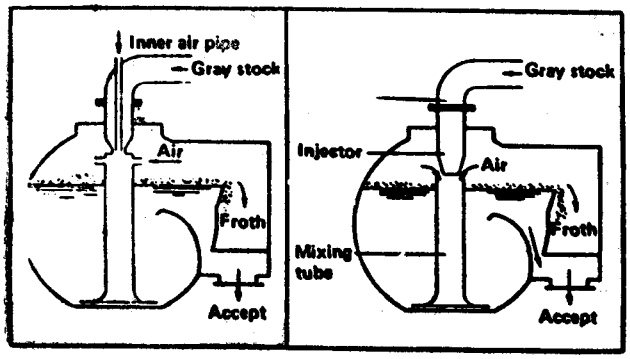
This method has the advantage that the filtrate coming from the Thickener and the Drqinator is virtually free from flotation chemicals and contains only fillers and fines. The Clarifier discribed above is thus not burdened with large and difficult to treat quantities of waste water as in the case of washing process.

Thus, the total ash removal, including flotation will be around 80%.


ANNEXURE - SKETCHES
Simple flotation-deinking system for medium quality demar ds and throughputs of 30-90 t/24h.
Contaminex S
Flotation-deinking system with deashing
Turbosorter
Turbosorter W
Flotation-deinking system for high quality demands with bleaching and dispersing stages
Dispersing Kneader or Disc disp. unit

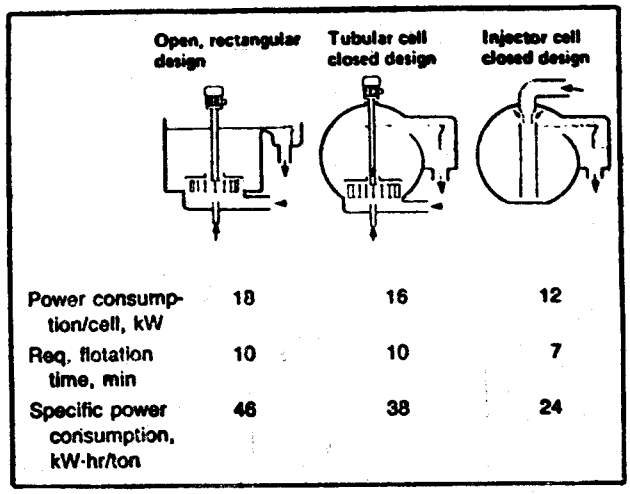



Closed, tubular flotation cell with injector.



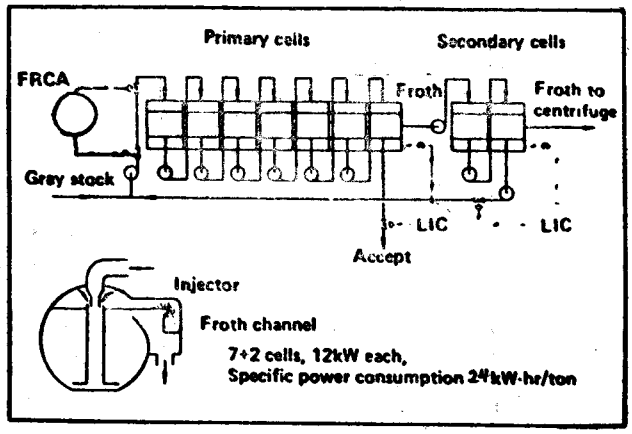

Injector flotation cell, optimized for high air intake.

Self-priming, open-injector flotation cell.




| | Open, rectangular design | Tubular cell closed design | Injector cell closed design |
|---|---|---|---|
| Power consumption/cell, kW | 18 | 16 | 12 |
| Req. flotation time, min | 10 | 10 | 7 |
| Specific power consumption, kW-hr/ton | 46 | 38 | 24 |

Comparison of different flotation cells.




Flotation cells with injectors and pumps.

CONCLUSION :

It has also been additionally established that due to alkaline treatment, the strenth of deinked stock is higher than that of waste paper: in respect of breaking length and tear factor.

In the recent years, the percentage of deinked stock in newsprint manufacture has gone upto a very high level. It is heartening to note that of late, many Industrialists in private sector, having understood the advantages of utilising deinked stock have come up with proposals for establishing newsprint projects which at one stage seemed to be an impossible proposition both due to shortage of raw materials and high cost for manufacture of newsprint based on virgin pulp.