The Complete Deinking Line For Printing And Writing End Use

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Deinking processes are widely accepted for recycling of printed waste paper to be used in newsprint, tissue and fine paper. More than 80% of the total deinking capacity is made by flotation deinking. The washing process has become predominant in the United States, and the flotation process in Europe and Japan. Asia has more than 45% of the total world flotation deinking capacity.

In Europe the installed capacity has grown to over 2 million tons per year during the last two years which represents an increse of 45%.

The recovery of waste paper is steadily increasing world wide. In Scandinavia 30% of the consumed paper and board is recovered, within the Common Market 32% and in Japan up to 48%.

In Scandinavia there are 7 flotation deinking installations with a total capacity of 1500 tons per day. Three of these use the waste paper for newsprint, three mills for tissue and one for market pulp and fine paper.

Background

There are in principal two different ways to remove ink from waste paper. One method is to disperse the ink in particles to a particle size as small as possible or below 15 micron. The ink can then be washed out in 2 or 3 stages. The other method is to agglomerate the ink particles greater than 15 micron and then remove the ink by a flotation process.

The washing deinking is a physical process of separation where the loosened and dispersed ink particles are washed out from the fibrous material by using several kinds of dewatering equipment.

The flotation deinking is a physical-process of ink separation. This is based on the phenomenon of different wetability with water of the ink particles. By addition of tensides the ink becomes hydrophobic while the fiber material is hydrophilic.

The hydrophobic surface of the ink is increased by addition of a chemical, called collector, normally a soap. When air bubbles are introduced into the suspension in a flotation cell, the ink particles are conveyed to the surface of the slurry to be concentrated as forth. In this form the ink particles can be removed easily by mechanical separation.

The advantages with the flotation compared to the washing process are :

—Higher fiber yield

—Lower water consumption

—Lower BOD—charge in the effluent

These advantages of the flotation process makes it understandable why the flotation method is so popular in Europe and Japan.

In this paper, a deinking system where a flotation and a washing process are combined, will be described.

The Flotation deinking Process

To increase the use of recycled printed fibers in different paper products, the following criteria are the most important for paper making;

—High cleanliness and stickies removal

—High end brightness

—Low production cost (energy, chemicals)

—Low fiber losses

To meet these demands the new advanced deinking process has to be used. The main steps in this process are :

*SWEDEN

—High consistency pulping
—High consistency (ca 2%) screening with holes and slots
—High consistency (1.5—2.0%) deinking
—Washing - Dewatering
—Bleaching
—Low consistency screening and cleaning
—Dewatering and storage before the PM
—Internal water treatment with ash removal

The different steps in this process will be discussed more in detail.

Pulping

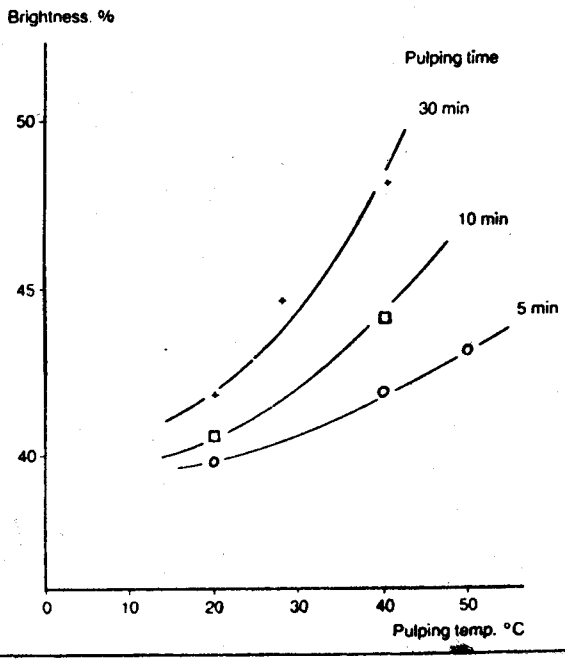
The advantages with high consistency pulping (15%) have thoroughly been discussed in the literature The evident positive effects are :

—Lower energy requirement
—Smoother treatment of the waste paper
—Better utilization of the chemicals
—More efficient removal of contaminants

The chemicals and pulping parameters have a great influence on brightness before the flotation cells.

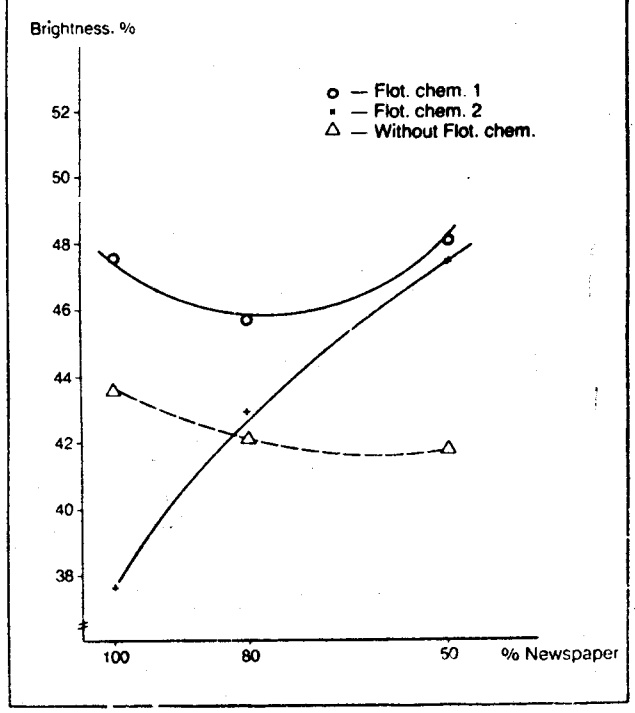
In fig. 1 the brightness after pulping is plotted againt waste paper quality and type of chemicals as parameter. As can be seen, the type of chemicals has a big influence on the brightness even when exactly the same waste paper is used. This has to do with ink particle sizes which have the greatest influence on the efficiency in the flotation deinking process and the brightness of the final pulp.

Fig. 1 **Brightness after pulper at different time and temperature.**



In fig. 2 the influence of pulping temperature and retention time on the brightness is shown. When 1% peroxide is used on a magazine/newspaper mixture, it is essential to use the best conditions for an optimal bleaching process, which is difficult in a pulper, as big variations in brightness can occur. It is quite common to add the peroxide in the pulper, but when the consumption of peroxide is more than 0.5% it is cheaper to use a separate bleaching tower after the deinking cells.

Fig. 2 **Brightness after pulper for magazine/newspaper with different flotation chemicals.**



Prescreening

Prescreening at consistencies around 2—3.5% is now an established technique and has been proven to be very efficient for removal of stickies. After a high density cleaner for removal of coarse contaminants, the pulp is screened in pressurized screens. The first one has holes of 2.2 mm and the next one slots down to 0.35—0.45 mm.

Flotation

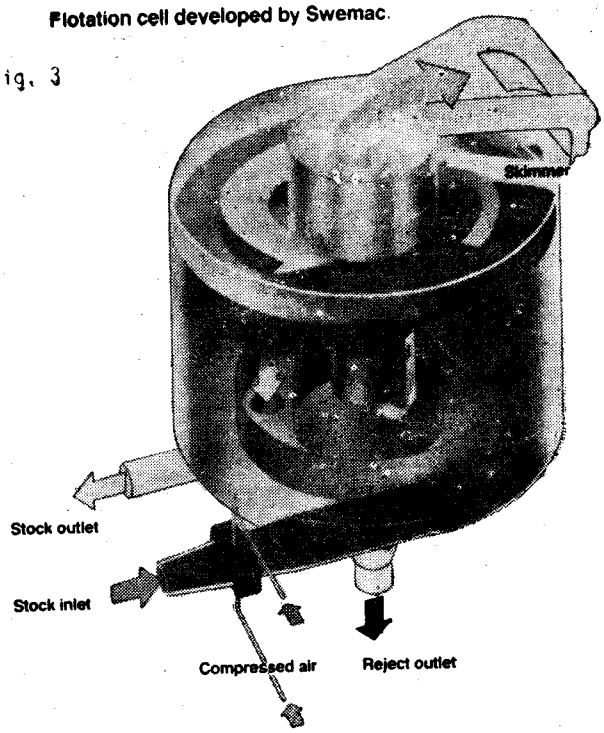
During the last five years there has been a rapid development of new flotation cells on the market.

The target has been the same :
—Higher pulp consistency
—Closed system
—No moving parts
—Low space requirements
—High reject consistency
—Increased pulp yield
—Reduced energy consumption

The SUNDS DEFIBRATOR (Fig. 3) flotation cells were the first on the market able to deink pulp over 1.5% consistency. As can be seen, the cell is quite closed and the foam is sucked out by an internal air circulation in the central pipe. During the last years 50 flotation cells have been sold worldwide to more than 30 different plants. The pulp from these deinking plants is used for newsprint, tissue, board, and printing paper.

Flotation cell developed by Swemac.

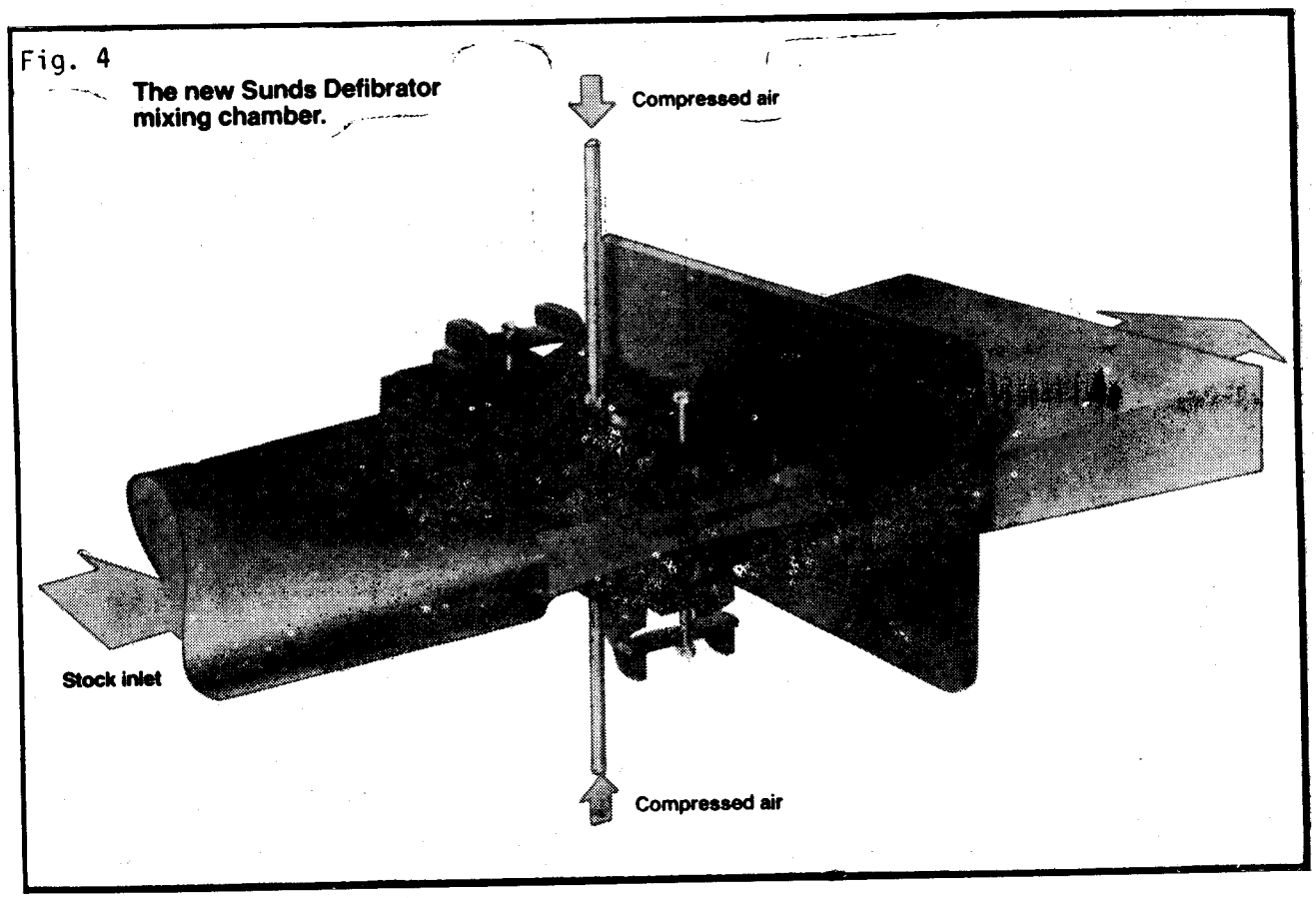
Fig. 3



One reason for this success was the new idea to mix pulp with air in a separate mixing chamber (fig. 4) outside the cylinderical cell. This gives great possibilities to control the bubble sizes.

Fig. 4

The new Sunds Defibrator mixing chamber.



In our laboratory trials with a mixture of newspaper and magazine (75/25) we have found that There is a relationship between ink removal and surface area which on its part is controlled by the air bubbles. Bigger bubbles are necessary when coated paper is deinked and smaller ones are required for news and ledger.

This air introduction and bubble size control results in considerably lower end brightness variations compared to other systems.

It is quite obvious that there is a correlation between the amount of reject and brightness increase in a deinking system. In all our trials (laboratory and commercial) the reject is kept below 10%. When magazines and newsprint are used, up to 60% ash can be found in the reject. That means that the fiber loss is less than 5% in spite of the fact that we use a single stage deinking system.

Washing and Dewatering

In all flotation deinking processes, the ink particle size varies fram 1—150 micron. It is essential during the pulping to get an ink particle size in the range of 15—100 micron. Small ink particles which have not been removed in the deinking cells will easily be washed out in the dewatering stage after the flotation. The amount of small ink particles have a great influence on the brightness. The water from that stage can be used again in the pulper, but we recommend to use a micro flotation system for cleaning this water which then can be re-used in the process. For tissue production, it is necessary to use a water cleaning system to decrease the clay content in the pulp and back water.

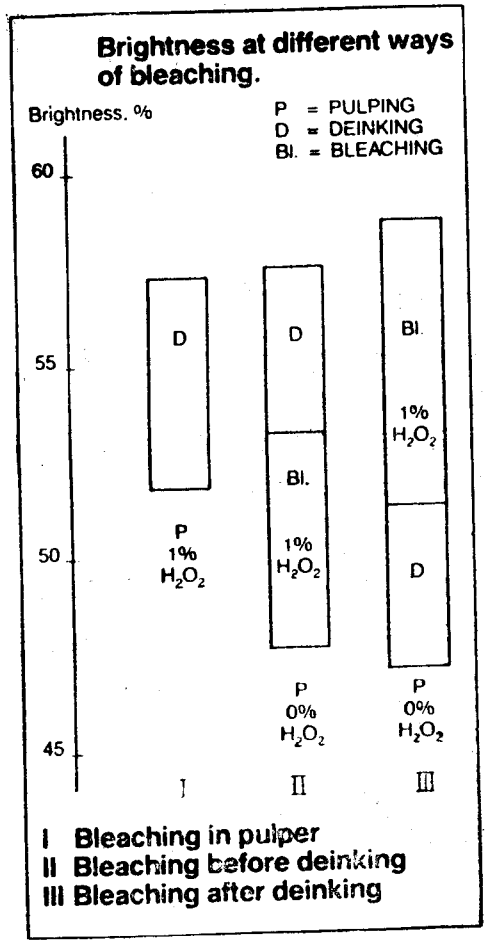
Bleaching

The use of peroxide as a bleaching agent is most common in flotation deinking. The amount of peroxide has a great influence on the total economy of a waste paper plant. In a 100 ton/day deinking plant the cost for each tenth percentage is around 30,000 USD/year.

There are three different possibilities to bleach deinked waste paper :

—in the pulper
—before the flotation stage
—after the flotation stage

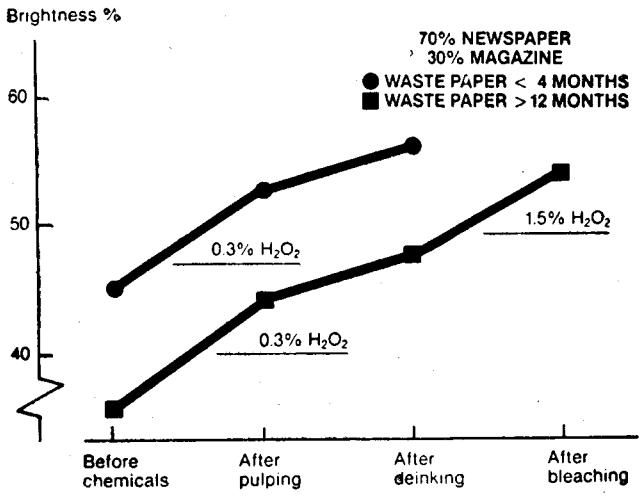
The air bubbles in the flotation cell provide a surface area to which the ink complexion is attached. it is more efficient to use theperoxide in a special bleaching stage after the flotation cells. In fig. 5 it can be eeen that bleaching in the pulper or in a bleaching stage before the deinking cells results in similar end brightnesses while a separate bleaching stage after the deinking cells gives 1.5 units higher brightness.



The reason for this is that the peroxide in an unfloated waste paper will be consumed by the ink. With a separate bleaching stage it is also much easier to control the end-brightness of the deinking pulp. As can be seen in fig. 6 a fresh waste paper does not need any peroxide in a separate bleaching stage while an old waste paper needs more than 1.5% peroxide to reach the same brightness.

A lot of investigations have shown that if waste paper is bleached when the ink is not removed the peroxide is consumed by the ink and not only by the mechanical pulp in the waste paper.

Fig. 6



Fine Screening

The fine screening starts with centrifugal cleaners which is necessary if fine slotted screens are used after the cleaner. For effective removal of sand and fine stickies, forward and reverse cleaners are recommended.

For the final screening pressurized screens with slots of 0.2–0.3 mm have proven to be very efficient.

Ash Remaval

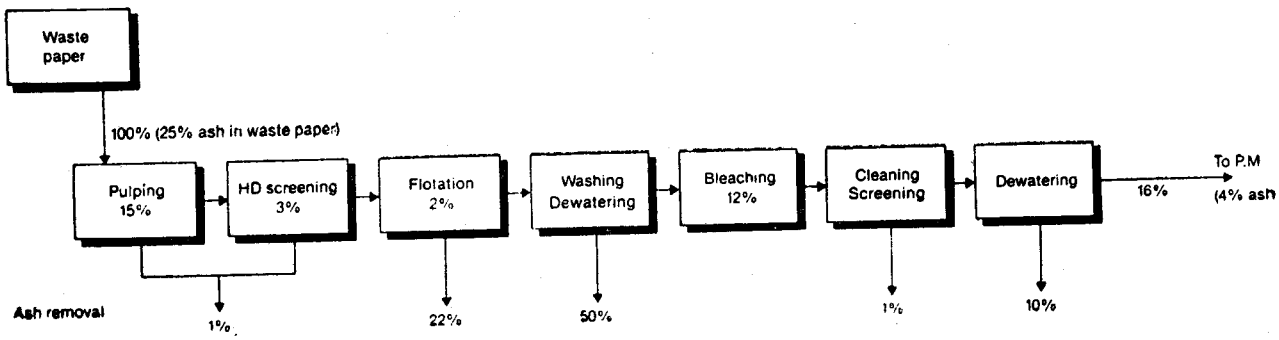
In waste paper plants for tissue pulp it is essential to remove the ash down to around 4–5% in the pulp to the paper machine. The ash content in the raw material can vary between 0 and 35%.

In fig. 7 we can see where the ash is removed in the process. In this example we have the 25% ash in waste paper and 4% ash in the pulp to the paper machine. 60% of the ash is washed out and more than 20% of the ash is removed in the flotation cell. The figure for the potential of the flotation cell differs very much depending on how much ash we have in the ingoing paper. Unfortunately it's very difficult to remove ash without removing fibers. But these fibers are mostly very small and around 70% of them will be washed out in the tissue machine if they are not removed in the deinking plant. The remainder of these fibers, that is 30% long fibers, can be recovered and brought back to the process by using fractionating screens.

Internal Water Treatment

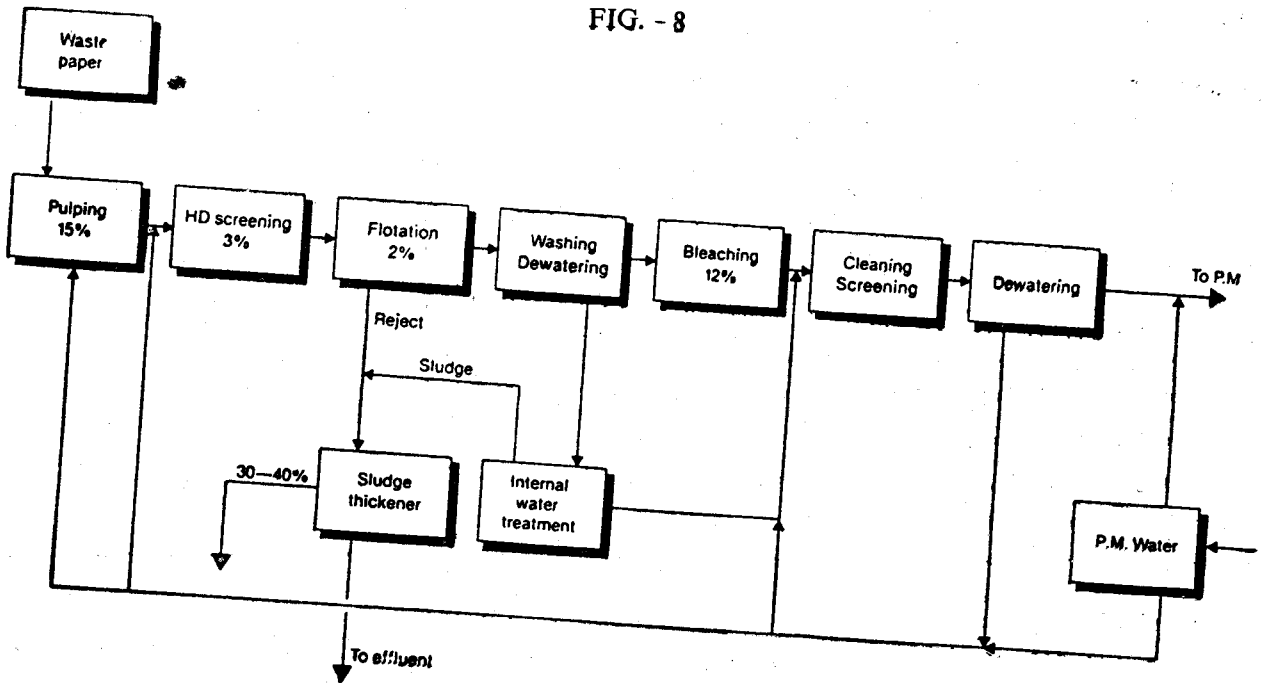
The filtrate from the washing stage contains except small particles as described above also clay and fibers. To remove the clay or ash content in this filtrate it is necessary to treat the water in the micro flotation plant. Before the micro flotation cell the water is treated with polymers to build up big fiber flocks. These fiber flocks are lifted up to the surface by adding dispersed air.

The cleaned water has suspended solids of around 100 mg/l and the reject from the cell has a consistency



of 3–4%, see flowsheet on fig. 8. This cleaned water is fed forward in the process for dilution of the pulp to the screening plant. The reject is fed either to a centrifuge or a band press to increase the dryness up to around 40%. The filtrate from the centrifuge or band-press is the only water leaving the deinking plant for external effluent treatment.

FIG. - 8



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