Application of Conventional & Enhanced Performance Fatty Acid Based Soap Collectors for Newsprint Applications in Flotation Deinking

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ABSTRACT

The first flotation deinking of German design was started in early eighties in India. Today the installed deinking capacity is around 1500 tpd with capacity of deinking varying from 20 tpd to 200 tpd. Many of the latest versions of deinking cells of European designs find their presence in India. More deinking units are likely to start in the years to come. Since the use have been more on the application of newsprint, the article mainly focuses on the prime deinking chemical of fatty acid based soaps of conventional and high performance widely used in Europe and to some extent in India. Various other process conditions and variables are briefly dealt with based in lab testing and field application. Brief comparison is also made with the uses of synthetic surfactants and other liquid combinations.

INTRODUCTION

For more than forty years, Europe is using fatty acid based conventional Sodium soaps in the flotation deinking plants. Particularly in the last two decades, there have been many advances in deinking equipment as well. These development have resulted in more efficient deinking processes.

While Surfactant based deinking chemicals are available, they have not displaced fatty acid based soaps to a great degree in Europe. This is particularly true for the large volume deinking of recycled Newsprint where Soaps have maintained a pre-eminent position till date because they give a better performance when factors such as brightness gain, yield, and newsprint machine runnability are taken into account.

In North America and Asia Surfactant based deinking chemicals have gained acceptance. However, European Mills in general use greater percentage of recycled fibre in the stock to the newsprint machine, compared to the North American Mills. Several European Mills are now running with

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100% recycled fibre on the newsprint machine.

The recent installations of several large newsprint recycling mills in the far East running with 100% recycled fibre on the paper machine has initiated a move towards fatty acid soap in Asia. Fatty acid Soaps appear to predominate where high levels of recycled fibre are used on the newsprint machine.

European newsprint furnishes have traditionally contained a very large proportion of Magazines. Typical furnishes have contained between 30 to 50% magazine with newsprint often less than three months old providing the rest of the furnish. Ten years ago, major proportions of a newsprint mill's waste paper come from print house over issues and returns.

Today more and more of furnish is post consumer waste. Post consumer waste is generally recognized as inferior in quality to print house over issue with variations in the amount of magazines and the age of the newsprint.The increasing use of post consumer waste represents a gradual deterioration of waste paper quality. With the increasing utilisation rates and poor collection rates, decreasing quality of waste paper supplies is a trend likely to continue.

SOAP SOLUTION PREPARATION

The conventional deinking soaps are either in the form of solid Needles or in the form of Pellets. Where as the Enhanced performance soap is generally in the form of Pellets. To ensure good dissolution of these soap Pellets in the batch operated high consistency pulpers of 12 to 15% consistency, the pellets are dosed in the pulper once the hot water of around 45 deg. C is taken in the Pulper but before feeding the waste paper in the Pulper.

Alternatively, a low cost manual or semi-automatic tailor made soap solution preparation arrangement can be made in the deinking plant itself. The requirements are-an elevated dissolving Tank of around 2 cubic metre capacity with a standard top mounted propeller/agitator for making a soap solution at a concentrations of around 50 to 100gpl, a Service tank (with out an agitator) to hold the soap solution for minimum 8 hours shift, a Metering pump with pipe line provision to feed the soap solution in the batch or continuous pulper.

The dissolution of the Pellets in the dissolving tank can be made by steam heating of water to 60-65 deg.C. Fluidity of the soap solution is essential with out gel formation for which insulation of the pipelines may be needed. We also recommend fitting of a manual valve in the service pipe line so that the line can be flushed with hot water or steam if for some reason the plant is shut for prolonged periods and there is a possibility of the liquid soap in the pipe line gelling. Some mills prefer to run this section at concentrations lower than 50gpl of soap depending on the plant convenience and the available size of the metering pump.

Such soap solution arrangement also enables the deinking plant to have the flexibility to dose the deinking liquid collectors to (a) full dosing at Pulper or (b) at the cell feed pump or (c) split dosing at pulper and the DI cell of first loop or in the second loop.

PERFORMANCE CHARACTERISTICS OF CONVENTIONAL / ENHANCED PERFORMANCE SOAPS AND SYNTHETIC SURFACTANTS

This fatty acid based Soap collectors in general tend to be,

(a) Moderate foaming with very consistent stable foam

(b) Very good in terms of Yield of finished pulp

(c) Relatively low water clarification costs.

(d) Moderate foam even at higher dosages, need reduced requirement of foam suppressants. Cleaner deinking circuit, stock preparation and paper machine areas.

(e) The soaps offer gentle action on ink and stickies and allows skimming of the buoyant type stickies efficiently from the cell due to more agglomeration.

(f) It gives good gain of Brightness across the cells & there by higher extraction of the ink particles out of the system.

(g) Soaps offer the possible savings in furnish costs or in some cases reduced post Bleaching costs for highly printed wastes

Yield is a major consideration for large newsprint mills with a very high daily throughput. For example, yield is a major criterion at one of the biggest newsprint mills in Europe and even 1 or 2% increase in yield is a significant increase in terms of annual out put, Admittedly this may not considered so significant in smaller newsprint units of India.

On the other hand, with pure Synthetic surfactants the dosages are very much low. The disadvantage with synthetic surfactants generally used to be,

(a) high foaming levels and the need to control such foam - often requiring the use of increased levels of foam suppressants or anti-foams

(b) Possibly significantly lower final yields because of increased foaming and increased removal of ash, fibres and fines.

(c) Possibly increased cost of water clarification chemicals.

(d) But even at these dosages, the actions of synthetic surfactants on ink is aggressive and disperse particles in smaller sizes than would be the case with soaps which can lead to small particles being re-circulated in the water circuit.

(e) Synthetic surfactants makes less gains during flotation than soap based products but make up for this during washing stages, at the cost of yield loss and grayness over a period of time.

However Synthetic surfactants at lower dosage levels are still in use if the above points are not considered as significant in a particular mill configuration. In Indian newsprint units, the dosage levels of synthetic surfactants vary from 0.20 kg/mt. to 0.8 kg/mt (or maximum 1 kg/mt) of input waste.

However in systems having per and post flotation, the synthetic surfactant is also dosed in the post flotation for simple control of overall brightness gain and for speck removal.

In some cases surfactants are used as synergist to soap collectors or as foam boosters. In case of white grade application and Tissue deinking units, they are used as low cost solution for Neutral or semi neural systems.

The moderate foaming of soaps and its potential for obtaining high gains across the flotation unit has also paved way for many developments with the deinking chemical suppliers for single product blend of Fatty acid/synthetic in optimal ratio in liquid form or two component chemicals supplied separately.

IMPORTANCE OF LEVEL CONTROLS AND OPTIMUM CONSISTENCY IN THE FLOTATION CELLS

It should be understood that all the inks dislodged/dispersed in the pre deinking area is to be extracted out of the cell with high efficiency. The ink knows only two routes- one to be extracted as scum out of the system or carried with the accepted pulp and be in the system or even carried to the mahcine areas.

Some mills in India are used to high foam levels for having used high foaming deinking chemicals. High quantum of foam is not the criteria for effective deinking in the cell and in fact the European deinkers look for consistent & moderate foaming deinking chemical which is stable in quality without collapsing with the ink. Hence in such cases of soap based collectors, the level of the stock in the cell has to be kept at a higher level than adopted for high foaming products. Lack of calcium results in smaller bubbles and makes the setting of the flotation cells more difficult.

There is one rule that must be observed. In flotation machines having secondary cells for handling the rejects of the primary, the accepts of the secondary cell going back through the flotation system must be at least 3 to 4 points higher in brightness compared to the feed stock brightness. Accordingly the cell operation has to be adjusted. The mills in fact, has to compromise with the secondary cell- between rejects rate and brightness attainment.

At 0.9 to 1% feed consistency of the cells good results in terms of brightness and speck reduction is obtained. This is applicable to all designs of cells. For want of proper thickening unit after the cells, the mills are forced to operate the cells at high consistencies due to limitations in the hydraulic capacity of the thickeners.

SYSTEM DESIGN AND ITS IMPACT ON DEINKING PERFORMANCE

Thickener type : Some mills have high efficiency double nip filters after the flotation machine as thickeners. These units may be of high utility value for the white grades of papers or for tissues. For market reasons when the deinking unit is to be operated with the same flow sequence for newsprint manufacture, then high washing units extract the high brightness fillers and fines leading to very high load on clarification units and ultimately to low yields. The performance of the cells gets very much disturbed because of the same. For newsprint applications efficient Disc filters are in regular used in Europe.

Post flotation and Post bleaching : Except a couple of mills, all other operating deinking units in India still have only pulper bleaching with hydrogen peroxide. If high gains between the Pulper & the complete deinking street is foreseen, then post bleaching with down ward flow Hydrogen peroxide bleaching followed by a well designed up ward flow Sodium hydro sulphite bleaching is a must, with an in between dispersion and post flotation units.

Filtrate water clarification : Gradual build up of various disturbing elements, ink particles in the deinking circuit take place, when the system is made fully closed with out any clarification of the thickener filtrate. The disturbing elements if not extracted out of the system will find the way to the newsprint machine affecting the quality and/or the steady performacne and runnbility of the machine. Depending on the process sequence, partial clarification of the filtrate of the thickener is suggested.

Difficulties in the use of Flexographic Printed inks in flotation : The flexo printing process is a form of letterpress printing using a soft plate-printing cylinder. Flexo inks are known as water based inks, as the inks binders employed are water-soluble. Papers printed with flexo inks have the reputation of poor deinking because a) the very fine flexo inks are difficult to float from fibre suspension b) while flexo inks can be removed by washing, it usually results in high losses.

To identify the content of flexo ink in a particular newsprint waste, the waste paper is pulped in a lab. pulper then diluted and filtered through a filter paper in a Buckman type filter funnel. The filtrate passing through the pad is to be observed. If it is only slightly grey then the waste paper is not flexographicaly printed. If the filtrate water is very dark it is almost certainly flexographic print. These relics on the fact that flexo-graphic ink particles are very small (below one micron) they tend to wash though the filter pad more than conventional inks. Flexo ink always lowers the starting brightness in the pulper. The best way is to avoid using the flexo-printed wastes, though there are some developments to use them in small quantities by means of specially desinged flotators in the filtrate circuit.

In the following pages we are placing the comparative findings of SERFAX Soaps in newsprint applications for flotation deinking:

COMPARATIVE FINDINGS OF SERFAX SOAPS IN NEWSPRINT APPLICATIONS OF FLOTATION DEINKING

SERFAX deinking Soaps of Stephenson Recycling Chemicals, Bradford, UK has been used in deinking applications for over 20 years. During this period Stephenson personnel have had plenty of time to establish the best possible working conditions for SERFAX soaps.

This short report shows how the following basic factors effect the efficiency of flotation using a newsprint based furnish.

- Water hardness
- Flotation cell pH
- Magazine content
- Application rate

STANDARD CONDITIONS

All the results contained in this report come from laboratory trials. In these trials standard conditions were used unless otherwise stated.

Standard conditions were

Furnish

70:30 news/magazine (European origin)

Pulping (Lamort Deinkit)	**Chemicals**
Consistency = 12%	Sodium Silicate (30° Baume = 2.0%
Duration = 15 minutes	Peroxide (as 100% active) = 1.0%
Temperature = 50°C	Caustic to pH = 10.5
Flotation (Lamort deinkit)	**Chemicals**
Consistency - 1.0%	$CaCl_2$ to 220 ppm as $CaCO_3$ (12°D)
Duration = 8 minutes	SERFAX Soap
Temperature = 45°C	

Unless stated Enhanced performance Soap SERFAX-DBE was dosed at 0.6% on fibre and Conventional deinking Soap- SERFAX mt90 was dosed at 0.8% on fibre. In the following findings mt90 represents the conventional deinking soap and DBE represent the High Performance deinking soaps of SERFAX.

FINDINGS

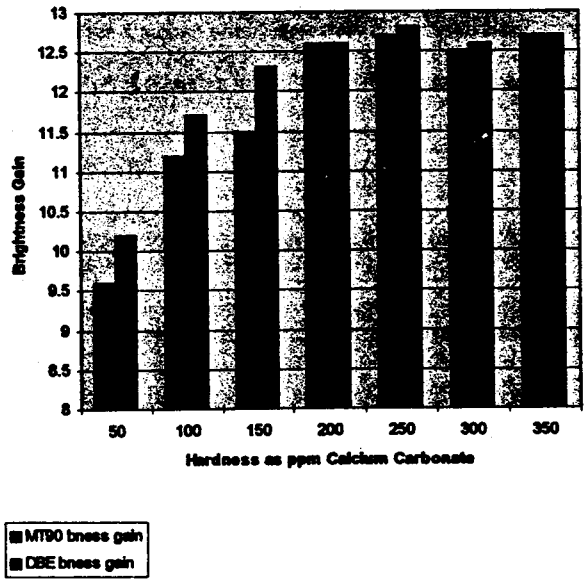
1) Effect of Calcium hardness on brightness gain

The graph no. 1 shows that the high Performance deinking soap-SERFAX DBE is more resilient to lower water hardness levels as at these lower levels it gives better brightness results than the conventional deinking soap- SERFAX mt90.

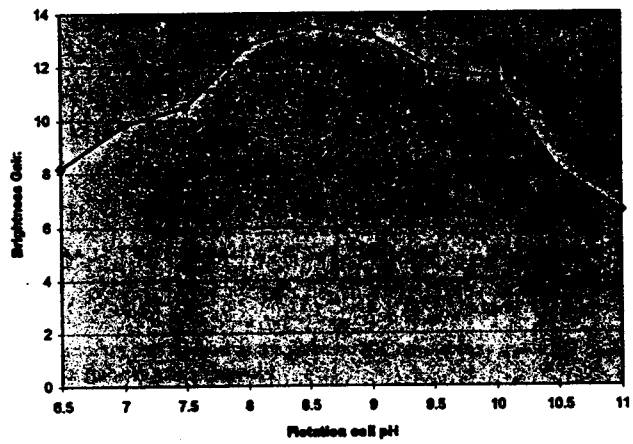
The graph also shows that Calcium hardness does influence brightness gain and that an optimum hardness is between 200 to 250 ppm as Calcium Carbonate. 12-15°D)

The calcium requirement is usually met by either the furnish, where Calcium Carbonate coated magazines are added or by the natural water supply.

Graph 1: EFFECT OF CALCIUM HARDNESS ON BRIGHTNESS GAIN



Graph 2: Brightness Gain as a function of flotation cell pH



If calcium levels are low (< 200 ppm) Calcium Chloride can be added either as a saturated solution (Usually w/w 35% solids) to the flotation cells or as solid flakes to the pulper).

2) Brightness gain versus pH

The graph no. 2 shows the brightness gain achieved as a function of laboratory flotation cell pH for both SERFAX soaps.

The graph shows that the optimum pH for both SERFAX soaps is pH = 8.5 however a range of between 8.0 to 9.0 is usually advocated.

Calcium soaps exist in equilibrium dictated by pH. At alkaline pH the sopas are present mainly as the Calcium soaps, necessary for effective deinking. At acid pH the soaps converts back to their fatty acid form. At intermediate pH the fatty acid and soap coexist. Control of pH is therefore important to avoid or resolve potential problems.

If the pH becomes too high then alkaline yellowing takes place, which causes the brightness to drop.

If the pH becomes too low then the deinking soap may revert back to the fatty acid and hence flotation will be compromised. As the pH falls the soap converts to the fatty acid species and that below a pH of 8.0 the conversion to the fatty acid species is very quick.

3) Flotation cell consistency

The graph no. 3 below shows the effect laboratory flotation cell consistency has on brightness gain when using any of the SERFAX soaps.

The graph shows that increasing the flotation cell consistency above 1.2% has a negative effect on brightness gain efficiency.

The graph was derived using a SERFAX soap of MT90 and DBE however the same relationship holds for most other deinking chemicals.

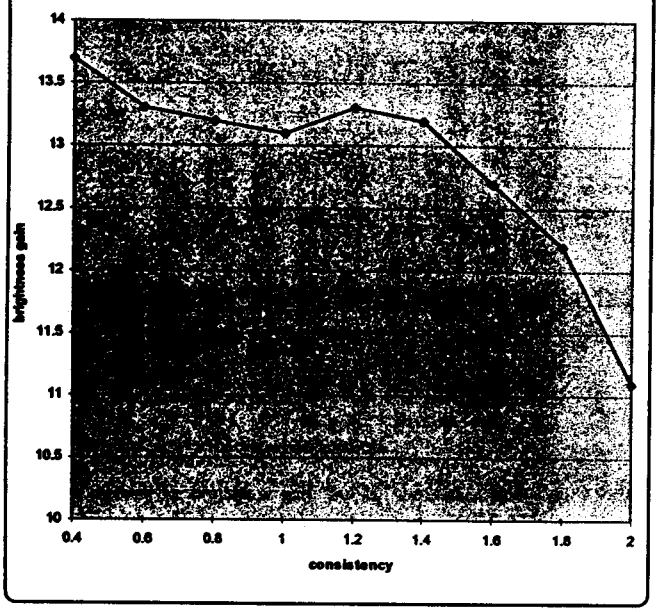
4) Magazine content versus brightness gain

The graph no. 4 below shows the relationship between increasing magazine content and brightness gain. (The rest of the furnish was made up of over issue newsprint of UK origin).

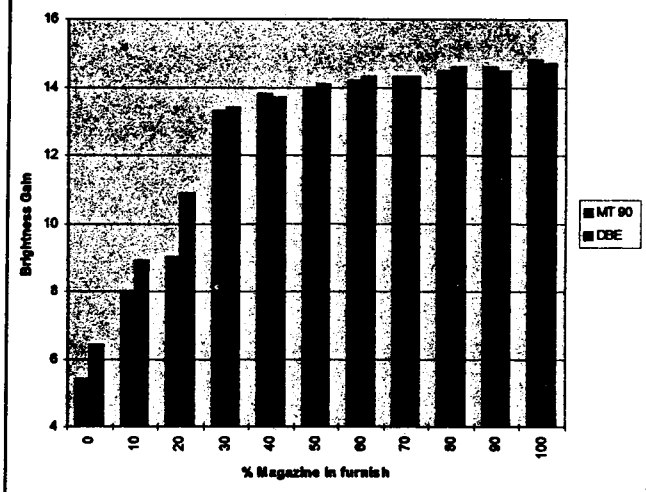
The largest increase in brightness gain can be seen when going from 20% to 30% magazine.

It is for this reason that a 70% newsprint 30% magazine furnish is usually recommended for

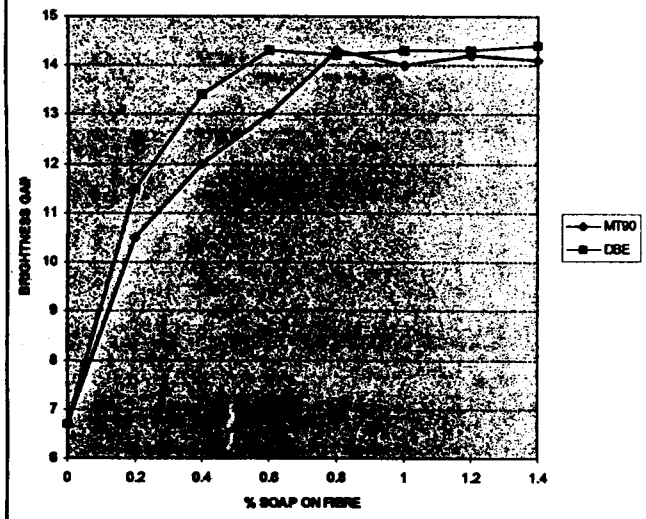
Graph 3: Flotation consistency versus brightness gain



Graph 4: Magazine content versus brightness gain for SERFAX soaps



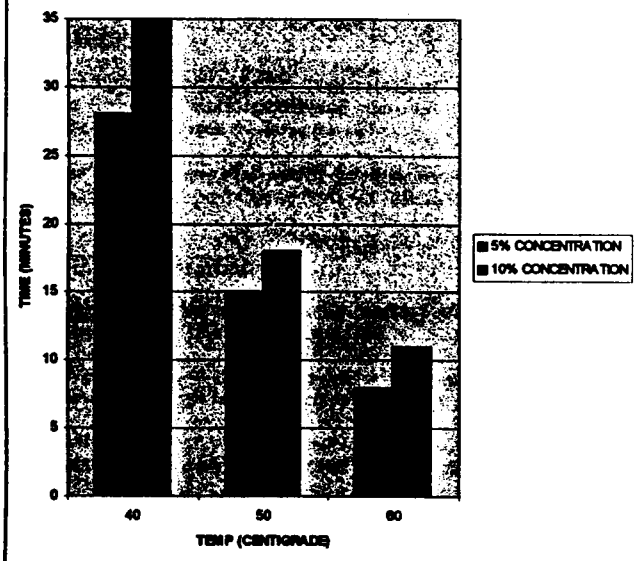
Graph 5: Soap application rate versus brightness gain



optimum brightness results in the deinking plant as it gives in most cases the best compromise between performance and cost.

The graph also shows that high Performance SERFAX DBE soap gives better results than the conventional SERFAX MT90 soap at lower magazine levels.

Graph 6: Solubility times for SERFAX MT90 and DBE (5 and 10% Concentrations)



5) Optimum application rates

The graph no. 5 shows that conventional deinking soap of SERFAX MT90 reaches an optimum application rate at 0.8% on fibre but the high performance SERFAX DBE soap reaches an optimum application rate at 0.6% on fibre.

6) Solubility times for SERFAX soaps (5% and 10% solutions)

The graph no. 6 shows the solubility times for both conventional and high performance soaps of SERFAX DBE & SERFAX MT90. It can be seen that as the temperature of water increases the time needed to dissolve the soap decreases.

OBSERVATIONS

The report shows that the main difference between high performance SERFAX DBE and conventional SERFAX MT90 is in the addition rate as laboratory results shows a lower addition rate can be used with SERFAX DBE with no loss in performance.

Also high performance SERFAX DBE soap contains a small percentage of synthetic additives, which allow the product to generate more foam than SERFAX MT90. This we believe explains the slightly better results with high performance SERFAX DBE at lower hardness and with lower magazine content furnishes.

CONCLUSIONS

For deinking plants running with "ideal conditions" in terms of water hardness and magazine content we would recommend conventional SERFAX MT90 soap as the preferred deinking chemical for use in that plant.

For plants using low magazine content furnishes and or with low water hardness we would recommend high performance SERFAX DBE as the preferred deinking chemical.

ADDITIONAL COMMENTS

This report is intended as a guide for working

with the conventional and high performance soaps of SERFAX MT90 and DBE.

It should be noted however that every deinking plant is different and that deinking chemicals should be optimised separately for each plant.

Although the report shows the best possible conditions for SERFAX soaps it should be noted that they would work in a variety of deinking applications under a wide range of conditions.

It should however be stated that all plants are different and application rates will vary and can often be reduced after the start up period. Every deinking plant operates in a unique way. Even two plants built to the same design are likely to yield different results - reflecting the complex relationship affecting deinking efficiency. Factors that influecne de-inking performance include Furnish, Pulping, Ink type, Printing process, Reagents, Equipment, Water quality, Process control, Economics, Environment etc.

The author thanks Stephenson Recycling Chemicals, Bradford UK for having permitted to part with their comparative testing of conventional and high performance soaps for newsprint applications.