

# Energy and Environment Management With Silicone Antifoams in Pulp & Paper Industries

Ramachandran K.N.

---

## ABSTRACT

*Resource conservation and environmental management are two key issues connected to Pulp and Paper industries all over the world. Several aspects of which have been studied in great detail and a variety of suggestions have come up in recent years. Foaming, recovery of black liquor, brown stock washing, pulp washing, etc. are the major areas which requires attention. Antifoam has been identified as a means to reduce foaming in the past. However several issues have been come up in late seventies with the usage of organic antifoam. One of which is dioxin precursor problems. Quality of pulp produced from the usage of such antifoam were not good. They lead to several black stains and are critical to acceptance of quality. They are though economic, are not efficient and it impair the quality of pulp. More over several safety hazards are also associated with the organic antifoam agents. Silicone antifoam has been identified as a major substitutes for the above and has been accepted by the Industry. They present several novel features and are effective at very level concentrations. These are available in various forms and can be added at any stage of pulp making. In general, silicone antifoam shows 5-times greater de-foaming effect than mineral oil antifoam. By using silicone, the water content in the pulp is reduced and thus saves energy in drying process. Silicone antifoam also shows 20% productivity V. organic antifoam.*

*In this paper case studies conducted in two Paper mills in Sweden and Finland by GE on new generation silicone antifoam AFP 2000 and general aspects of antifoam are presented. It has been found that this material is superior over organic antifoam. The material helps in saving energy, increases the net productivity and reduces environmental release of dioxins. It also helps in greater soda recovery and lowers the deposition.*

---

**GE Silicone India (P) Ltd.,  
No. 5 Crescent road, High grounds,  
Bangalore-560 001 (Karnataka)**

## **ENERGY AND ENVIRONMENT MANAGEMENT WITH SILICONE ANTIFOAMS IN PULP & PAPER INDUSTRIES**

Resource conservation and environmental management are two key issues in paper and pulp industry. It consumes a vast amount of energy, resources and end up with release of various hazardous pollutants. Effluent, sulfur dioxide, hydrogen sulfide, mercaptans are major pollutants from the industry. In addition the use of organic compounds like mineral oil based antifoam and other material highly hazardous dioxins in to the environment. Several process are involved in paper and pulp manufacture and each stage contributes to a certain amount of load in environment.

Brown stock washing is one of the important operation in Kraft pulp manufacture. The performance of down stream operations such as bleaching and black liquor recovery are associated with it. The poor washing lead to high bleaching costs, excessive chemical loss and increased effluent treatment expenses. In Kraft pulping, lignin is degraded in to a point where the fibers can be separated, washed and bleached. The degradation products are dissolved and dispersed in the liquor, adsorbed on the cellulose, and trapped within the fibre cell wall. The challenge of washing is to separate maximum lignin from the waste in a most economic and efficient way.

Understanding of application of anti foams is more important in Indian context. Indian resources of pulp are limited and our industries are concentrating on adaptation of baggase, and agro wastes in as source of pulp. This is having lot of challenges and the conventional approach will add not only add additional cost to the production, but may lead to environmental hazards. Pulp production from the above products leads to much foam than traditional methods and a shift is required to get a quality pulp. Use of anti foams for improved washing is a universal approach and are necessary as it affects economics of pulp production. It also prevents vats from overflowing and improve washer operation.

They are widely employed and are available in the form of compound, gel, fluids and emulsion.

Literature indicates that crude materials such as kerosene and petroleum hydrocarbons were used for to foam control in paper mills. However the pulp manufactured using mineral oil based anti foams have been reported to contain dioxin precursors. These dioxins are one of the worst known poison to man with LOD values less than 2ppt. The other problem with paper from such pulp is stain and black spots.

Hence most of the industries are switching from organic products to silicone anti foams. Silicone anti foams provide advantages including.

- Undetectable dioxin precursors
- Better washing that reduces the soda losses and yielding a cleaner stock
- Lower deposition tendency.
- Improved drainage which improves the productivity
- High cost effectiveness.

In this paper it is proposed to discuss some the results of case studies and trails at pilot plants in Sweden and Finland with a new generation of silicone antifoam. The results of the case study will be discussed in this paper. The potential of pulp & paper antifoam is estimated 2000 tons per year in Finland and 3000 tons a year in Sweden. GE anti foams AF 93 and AF 9030 are widely used and are shifting to AFP 2000.

### **LAMINATING PAPER, ENSO GROUP, JULY 29, 1996**

#### **Current process**

Pulp Source: softwood saw dust

Production: 240K tons pulp/year

AF product used: AF 93, 330 Klbs/yr.  
ORGANIC: 1400 klbs/YR

#### **Trial**

Production: running at 50% capacity

AFP 2000 usage: 1/4 AF 93 usage.

## **Pulping process**

Saw dust is fed to a cooker and cooked with white liquor at 175 degree centigrade and 10Pa pressure. Composition in the cooker is 78% saw dust and 22% white liquor. The residence time of the material in the cooker is approximately 10 min. After cooking the mixture is transferred to a post reactor and further cooked at 175 for 3 min and 180 degree in a secong post reactor. A positive pressure was maintained in both reactors. After this the mixture is blown down to a silo and pressure is released. About 50% is extracted as a clean pulp slurry. The clean slurry contains about 5-6% pulp which further concentrated to contain 10% pulp as a product. The remainder from the extraction, known as brown stock is pumped to a washer, where pulp is extracted and concentrated in to final pulp product.

## **Brownstock Wash**

At laminating Paper a vacuum washer is used. The washer contains a series of 4 drums. (Fig-1). Each has a diameter of about 10 feet. The brown stock is fed to the front end of the Trough and the pulp is picked up by the drum by via vaccum and carried over the top and discharged and re-dispersed in the rear end of Trough A. The process continues till the final pulp is produced.

Foams are created in the washing process with foaming being severe in trough A and lessens gradually. The liquid level in the troughs should be maintained at all time. At any time when it exceeds the predetermined level the entire washer turns off. To maintain the liquid level an antifoam is fed to the brown stock before it is fed to the washer. In most cases it is necessary to feed the same antifoam to trough B. When an inferior antifoam that does not have a good long term antifoaming persistency is used an additional dosage is also has to be fed to control the foam. AFP 2000 was fed to the influent brown stock and at trough B at the same rate.

## **Observations**

### *Quantity:*

Organic antifoam: 1.5 ton

Silicone antifoam: 400 kg

### *Energy saving (net)*

Organic antifoam : Reference

Silicone antifoam : 20%

### *Black Spots*

Organic : Plenty

Silicone : Negligible

### *Dioxin Precursor*

Organic : Detected

Silicone : NO

### *Bio compatibility*

Organic : No

Silicon : Yes

### *Environment Friendly*

Organic : No.

Silicone : Yes

### *Efficiency & Economic:*

Much ahead of other antifoam

### *Evaluation:*

Standard methods.

### *Trial:*

Success.

## **UPM-KYMMENENE OY, KAUKUS**

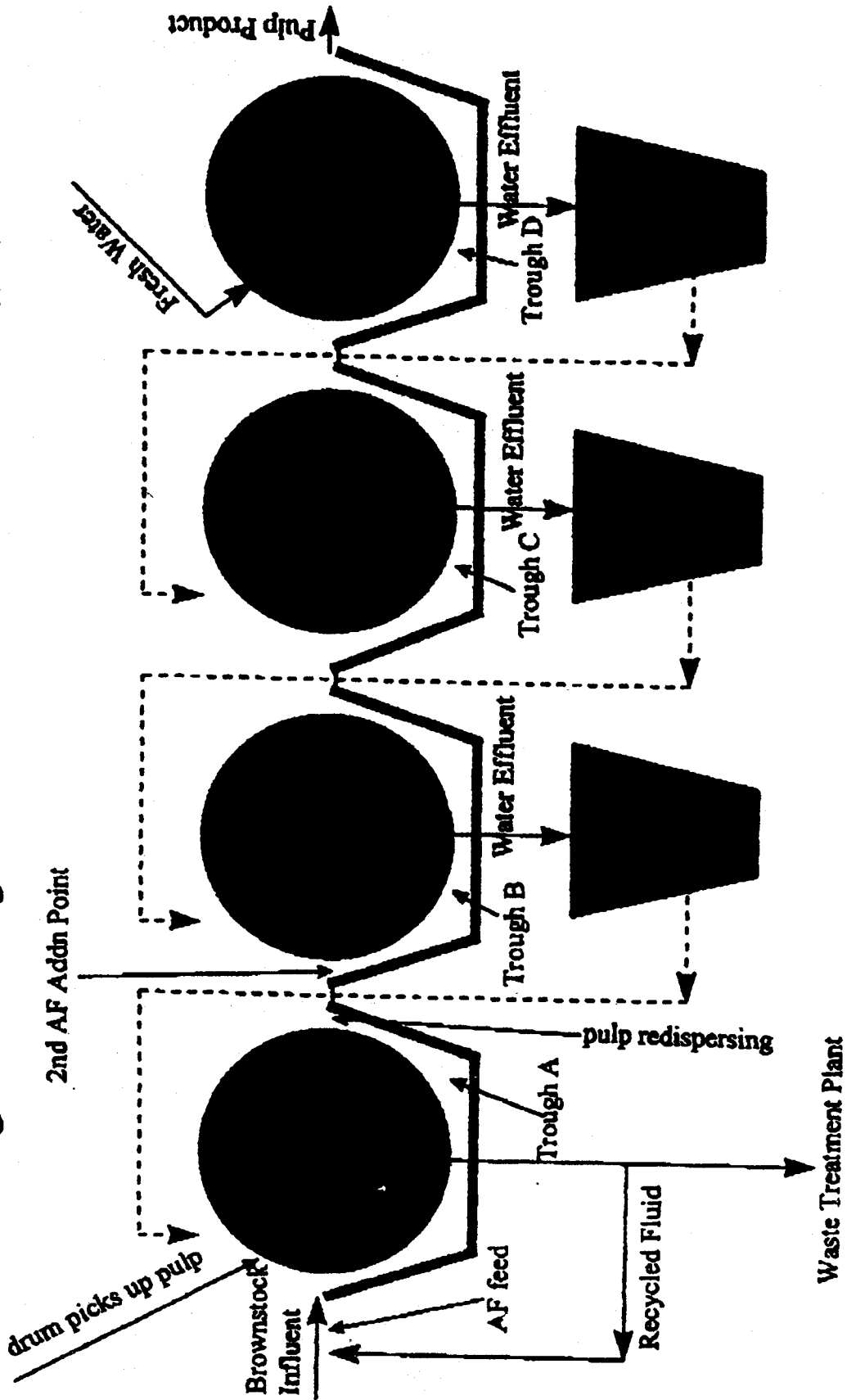
### **Current Process:**

Pulp source: Soft wood and hard wood

Production: 540 K tons pulp/yr<sup>9</sup> current).  
780 tons/yr. 912/96)

AF Product Used BS 470, 819 Mlbs/yr.

Figure 1. Configuration of a Vacuum Drum Washer.



## Trial

Production hard wood line

AF: AFP 2000 from GE

Projected use: 200 Mlbs.

## Experimental Trial:

1:1 replacement by AFP 2000

Kaukus uses a new design washer known as Displacement Drum Washer (DD washer) which has more compact design than VDW that is used in laminating paper. (Fig-2). Antifoam was fed at section D where fresh water is fed which is different from VDW. The foam condition and in turn washing efficiency is monitored with a computer at Kaukus by measuring conductivity of the effluent and the productivity of pulping. When foaming increases conductivity increases and productivity decreases. The pH becomes 10-11 and temperature is about 90 degree.

## REPORT ON KAUKUS TRIAL WEEK 34

The Kaukus produces 1700 tons of paper pulp per day!

At atypical usage of 0.6 kg of antifoam per ton pulp this translates to 1022 kg/d or 371 t/a in one pulp mill alone.

## Process:

Antifoam is almost exclusively added in the washing unit and at the beginning of the water feed. The objective of the washing stage is to separate as much of the degraded lignin from pulp fibres in the most efficient way. Sometimes, Antifoam is also added to bleaching unit if there are foaming problems. Its purpose is to make air bubbles coalesce so that air comes to the surface of the black liquor, and is lost. This improves the washing efficiency. The pesemo consists of three units. They

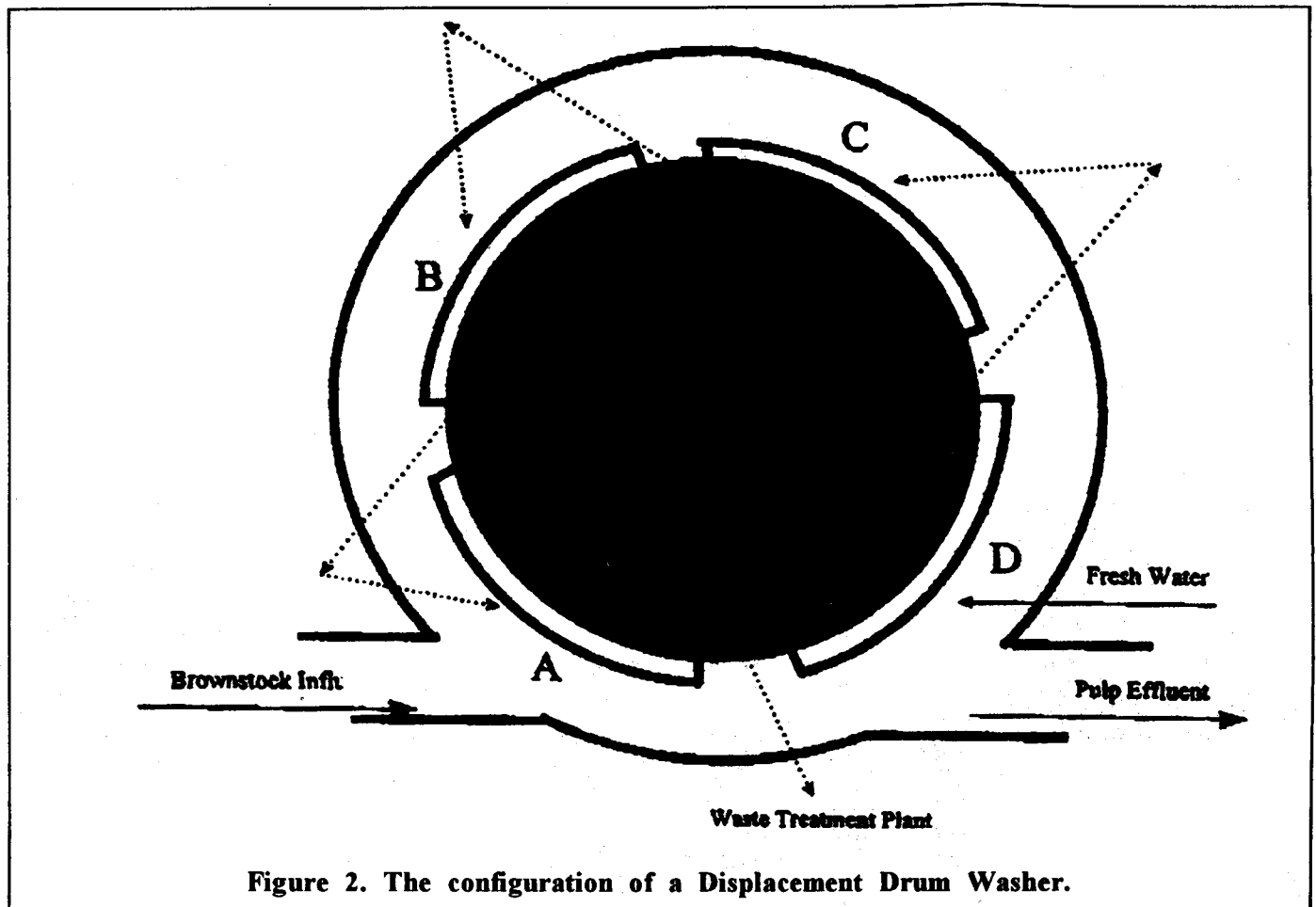


Figure 2. The configuration of a Displacement Drum Washer.

are I. Okaseula or Knotter, II. Pesuri or Drum Displacement (DD0) Washers: and Suostin or Water Thickeners.

The pulp comes from digestion stage to the washing unit so that residue of NaOH/Na<sub>2</sub>S can be removed. Na is recovered from the black liquor in the Na recovery module. It is here Antifoam is removed by burning. There is no perceived environmental issue. But organic antifoam liberates dioxins. After washing pulp is filtered and bleached. Water comes in to Suostin from the down stream units and is therefore is alkaline. The liquid or liquor then passes upstream from the Suostin to the Pesuri and finally to the Okaseula, progressively becoming more and more dirty and loaded with degradation lignin products, contaminants and other undesirable by products. The effect is that liquor becomes more conductive. Foaming tendency is also increased. The resulting liquor is stored in 660 tone holding tanks and then is treated prior to being disposed off. As the liquor is held in such vast holding tanks, at a typical flow rate of 90lt/min, it would take about 2hrs, before any additions of Antifoam would work its way through the system. Future trend will be more closed water systems. This will invariably lead to even dirtier water with high conductive liquor. Foaming will also be more severe.

There are 2-30 tones holding tanks for Antifoam. One for organic Antifoam used in the softwood line 2t/d. and the other for silicone Antifoam used in the hard wood line (500-800 kg/d). Antifoam is metered into the washer unit via 6 Zickert (WTP) meter pumps and 3/4 " pipes. For trials either material is pumped into the holding tanks and metered. The temperature of the plant, and hence the Antifoam totes, is always about 35 C.

### **Trial**

1<sup>st</sup> Phase

22<sup>nd</sup> August.

9.30. Started adding Antifoam.

11.30 Foaming was too much in 1&2. Production slowed down to 829 p-t/d. Meter pumps were checked and found they are not pumping very efficiently.

11.48 Foaming was brought under control

12.30 Production back to ca. 1029p-t/d.

15.32 A simple calculation indicated that in a short time of 1h there was a loss of production of 20%, i.e. 9p-t. At a selling price of 625/p-t this equates to a loss of \$ 6000 to Kaukus, 10hrs equates to \$ 60,000. Productivity increase by 25% was found with silicone antifoam.

## **II. Second Phase:**

22<sup>nd</sup> - 23<sup>rd</sup> August

By measuring the Antifoam usage directly from the tote instead of relying on the values generated at the check points, and noting the total output it was able to chart the efficiency of the Antifoam in kg/p-t.

### **Conclusion:**

On 22nd August 8.50 A.M. B.K. gave a usage of 470 ml/min. By 10.30, on 23<sup>rd</sup> AFP 2000 gave a value of 183 ml/min. This was equal to 39% less for AFP 2000. These numbers are good and has been accepted for routine production.

### **CONCLUSION**

The AFP 2000 from GE Silicones is a new generation antifoam available for pulp and paper industries. This antifoam helps in saving energy and does not liberate dioxins or dioxin precursor as in the case of organic antifoam. The productivity increases about 20 % in average. This enables high cost effectiveness and improved drainage. It also helps to have better soda recovery and lowers the deposition tendency. It is bio degradable and an environment friendly product.

### **REFERENCES**

1. Kevin Chugg, General Electric, Personal Communications, September 12, 1996.
2. UPM-Kymmene Oy, Kaukus.
3. Report on Kaukus Oy Trial Week 34.
4. R. Pelton, A review of brownstock defoamer fundamentals, PULP WASHING, Pulp & Paper CANADA, 90:2 (1989).