# Application of Digester Cooking Additives in Pulping

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**Use of Anthraquinone in delignification of pulp is known and proven fact. Anthraquinone improves the pulp quality and yield by accelerating the delignification process. It has certain limitations and apprehensions that pro-logned use of Anthraquinone @ 0.4-0.5% can cause deposition in boiler tubes. This paper shows that new generation ethoxylated alcohols and Di-alkyl-phenol surface active agents in combination with phosphonates and dispersing agents proved to be better option for pulping of various type of raw-material like hardwood, bamboo, agricultural residues etc. Pulping conditions in India has significant role due to scarcity of long fibre, variation in raw-material and poor fibre quality. The novel digester additive proved to give better pulp yield, shorter cooking cycle and saving in bleaching chemical.**

## INTRODUCTION

The pulp manufacturers use anthraquinone and other Digester Cooking Additives to improve rate of delignification in cooking. Anthraquinone helps to improve the pulp yield but it has certain disadvantages also due to poor solubility. So many papers have reported deposition in recovery evaporators in prolonged use of Anthraquinone alongwith alkali. Although Anthraquinone is being used since long back to improve the yield and to produce low kappa no. pulp, but its use has been a debatable issue.

In recent times so many other Digester Cooking Additives based on surface-active agents, phosphonates etc. have created a place in pulping. Various products based on Ethoxylated Alcohols and Di-alkali, Phenols, Polyethers are being used worldwide to obtain different type of benefits as per the requirement of pulp makers.

For Indian Paper Industry procurement of raw material is the biggest issue and we face acute problem due to variation in quality of wood, difference in quality of agriculture residue fibre as per change of season. The need of some additives to maintain the strength properties, uniformity of pulp even after using a variety of raw materials is needed from long time. In case of mixed variety of furnish and unseasoned wood, the screen rejects becomes very high and the alkali requirement goes up. It has been noticed that even by increasing the active alkali, the rejects come under control but other problems arise like yield loss and reduction in strength properties.

A new generation product based on eco-friendly, bio-degradable surface active agents have resulted not only better pulp yield, but also contributed towards lowering down the effluent B.O.D. and C.O.D. loads by reduction of active alkali and bleaching chemicals. Most of the paper mills in India are using regularly Digester Cooking Additives for various purposes depending upon the requirement of particular mill. The major focus is to bring down active alkali consumption per tonne of pulp due to bottleneck of recovery or to increase the production without going in for major capital investments.

### Mechanism

The new generation Digester Cooking Additive is combination of different ingredients like wetting agents,penetrents, dispersing agents and stabilizers. The formulation depends upon the requirement of end consumer and plant conditions. Anmopulp enhances penetration of cooking liquor into wood chips, agriculture residue and other raw materials making lignin easily accessable. It enhances delignifications rate due to change interfacial tension, surface tension and contact angle. In this process lignin in wood chips is chemically attacked by the Hydroxyl and Hydrosulphide ions present in cooking liquor and the lignin fragments are dissolved as phenolate or carboxylate ions which is emulsified to check redeposition and washed

away during pulp washing stage.

## RESULTS AND DISCUSSION

After conducting the initial laboratory trials so many mills have gone into use of in their system for getting benefits like increasing the pulp mill production capacity, reduction of cooking cycle, improving pulp yield by lower rejects at a given K. No. The studies have shown that bleaching chemicals can be reduced by 10-15% by using this new product. Use of this product have shown reduction upto 25% in pitch content and DCM extractives. The pulp obtained is more uniform while cooking, mixture of different raw-materials.

This product has been proved suitable for hardwood, softwood and agricultural raw-materials. Various studies by different paper mills have shown that by using a combination of and Anthraquinone, gives better results in comparison to Anthraquinone or Surfactant based Digester Cooking Additive alone.

### Case Study-I

This mill has been offered Anmopulp-MICR to be used in digester to reduce the alkali or cooking time knotter screen rejects. Pulp production capacity 170 TPD and furnish is mixed hard wood including poplar, Bamboo, Veneer waste etc.

### Observations

1) The alkali was reduced by 5%, 7 & 8.5% & 10% the K. No. was within limits.

2) The cooking cycle was reduced by 30 minutes and the K. No. almost within limits.

### Remarks

After observing above results it was decided that this new product has given appreciable results. However, both alkali reduction and reduction in cooking cycle is to be optimised in prolonged plant run.

**Table -1**

| Capacity (TPD) | 170 Mixed Hard Wood | 170 Mixed Hard Wood | 170 Mixed Hard Wood |
|---|---|---|---|
| Alkali Charge % | X | X | X-10% |
| Cooking Aid % | 0 | 0.1 | 0.1 |
| Cooking time minutes | 75 | 45 | 75 |
| K.No. | 22 | 22.2 | 21.7 |

### Case Study-II

This mill has been offered this product for conducing plant trial. To overcome the bottleneck of limited capacity of Soda Recovery by reducing the active alkali charged to the digester, two successful plant trial were taken in April-June, 2001 and August 2001. In the continuation of this a further trial was planned to explore the possibility to reduce cooking cycle digester by reducing cooking time and to make absorbent grade pulp with lesser active alkali charge/digester.

### Observations

1. Cooking aid was added @ 10kg/digester i.e. around 1 kg/tonne of B.D. unblached pulp produced.
2. Average K.No. has been observed 14.9 during blank trial with double stage cooking having 90 minutes cooking time compared 14.2 K.No. with cooking aid in double stage cooking.
3. Average K.Nos. have been found 13.0, 13.3 & 14.0 with cooking aid in single stage cooking having cooking time 75 minutes, 60 minutes and 45 minutes respectively.

**Table -2**

| Cooking Stage | Double | | Single | | |
|---|---|---|---|---|---|
| Alkali Charge % | X | X-8% | X | X | X |
| Cooking Aid % | 0 | 0.1 | 0.1 | 0.1 | 0.1 |
| Cooking time minutes | 90 | 90 | 75 | 60 | 45 |
| K.No. | 14.9 | 14.2 | 13 | 13.3 | 14 |

**Remarks**

1. Cooking time may be reduced by (30-40%) i.e. from 75 minutes to 45 minutes using cooking aid in normal kraft pulp. Preferable 20 minutes shall be safe reduction in cooking time.
2. Active alkali charge/digester can be reduced by 6-8% in both type of pulp i.e. absorbent grade pulp as well as in normal kraft pulp.

**Table -3**

| | | | |
|---|---|---|---|
| Alkali Charge | % | X | X |
| Cooking Aid | % | 0 | 0.1 |
| Anthraquinone | % | 0.125 | 0 |
| K.No. | | 16.4 | 16.3 |

3. In view of the reduced K.No. after addition of the Anmopulp-MICR it may be possible that this cooking aid may be used in future for denser species which are difficult to cook as it improves liquor penetration in chips cooking through wetting out mechanism.

**Case Study-III**

Mill No. 3 is producing approx. 350 TPD pulp and raw material is hardwood (Sababul+Eucalyptus+Casurina) & bamboo mix.

**Objective**

The trial of this product was conducted to replace Anthraquinone and to reduce the knotter rejects.

**Observations**

1. Reduction in active alkali consumption was 8%.
2. Knotter rejects position was within control.
3. Variation in Kappa No. was also reduced.

**Case Study-IV**

The trial of this product (Surfactant) in combination with Anthraquinone was conducted from 07-11-03 to 15-11-03

**Objective**

To study the effect of surfactant in combination with anthraquinone for reducing active alkali consumption during cooking, without affecting unbleached pulp $KmnO_4$ no. and also to observe its effect downstream.

**Table -4**

| | | | |
|---|---|---|---|
| Alkali Charge | % | X | X-8.2% |
| Cooking Aid | % | 0 | 0.05% |
| Anthraquinone | % | 0 | 0.39 |
| K.No. | | 14.3 | 14.1 |

**Observations**

1. Active alkali consumption was reduced by 8.2%.
2. There was no chagne in cooking cycle time, as our aim was to reduce active alkali consumption.
3. Knotter screen rejects rate comparable may be slightly lower.
4. There was slight increase in foaming tendency in Wash plant.

**Remarks**

Combination of Surfactant and Anthraquinone prove to have better effect in active alkali reduction during cooking rather than surfactant alone and has potential of reducing alkali consumption by about 8.0% when compared with no surfactant use situation. In order to fully establish the total effect of chemicals in system, a longer trial run of minimum one month is proposed.

## CONCLUSION

The new surface active agent is bio-degradable, is an efficient pulping additive for various types of fibrous raw material with respect to reduction in cooking chemical, cooking time, reduction in kappa number of pulp thereby, reduces bleaching chemical consumption and increase in pulp and increase in pulp yield. Therefore, the new pulping aid is very much useful from various aspects during pulping process as per the requirement of the user/pulp manufacturer,

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