Studies on Slime problem in Paper Mills And Its Prevention

Subash Chand
R. C. Gupta
K. L. Ghosh

Introduction :

In paper mills, a number of organic products are handled, which act as nutrients to bacteria and fungi. Excessive growth of micro-organisms in paper mill system leads to many undesirable effects which interfere with the normal operation of the mill and sometimes make the final product unsuitable. Excessive microbiological growth in the system may lead to slime formation, corrosion, decomposition of cellulose, creation of bad odour and spotting of paper.

Paper mill slime is a mass of stingy, pasty, gelatinous matter and usually consists of micro-organisms, fibres, fillers and fibre debris. Slime, by accretion, reduces the effective diameter of flow through pipes and plugs the felts and wires. The slime deposits may grow to such an extent that they break loose from their point of attachment and are carried with the stock to the paper machine causing break in the wet paper or forms slime spot in the finished paper.

Amongst the micro-organisms, bacteria and fungi are the principal causes of slime formation. Bacterial slimes are produced by both spore forming and non-spore forming species of which the latter can be easily controlled by the use of toxicants. Holmes[1,2] reported that the spore forming bacteria forms very tough, rubbery slime, which is extremely resistant to heat and chemicals. Usually, the slimes produced by fungi are the result of tangled mass of filaments, which entrap other ingredients-fibres, fillers etc. Bacteria produces more slime than fungi, although Pearson[3] reported slimes in Swedish paper mills as more due to fungi than bacteria.

The growth of micro-organisms can be prevented by general cleanliness of the mill, by the action of heat and toxicants. The action of heat destroys the nonspore forming bacteria completely, but not the spore formers[4]. The toxicants generally used are chlorine, chlorinated phenol and mercury compounds. Griffin[5] claimed that the chlorination to the point of a chlorine residual killed most of the micro-organisms within a few minutes. But the use of chlorine is restricted by the fact that some of the bacteria and fungi are not controllable in acceptable usable concentrations. To overcome the reactivity of chlorine with organic matter, chloramine is used, particularly where there is a high concentration of lignin and organic matter. Sanborn[6] reported that chlorinated phenol compounds are highly toxic to bacteria, fungi and algae and are able to remove even the most resistant micro organisms. Besides the above toxicants it has been found that organomercuric compounds are also extremely effective in controlling both bacteria and fungi. But the use of mercuric compounds are limited due to the fact that these cannot be used as slimicides for food wrapping papers and also the fish in lakes and rivers which receive effluents containing mercurials can not be used for human consumption.[7]

Experimental and results :

Samples from different spots at the mill, were collected aseptically and plated on Tryptone glucose agar media to obtain total bacterial counts at different points in the mill system. Plates were counted after 48 hours of incubation and total plate count for each sample has been reported in table 1.

For laboratory evaluation of different slimicides, paper mill slurry (white water) was used as the medium during the contact period between the test organism and the toxicant. In making the test, 100 ml samples of mill water are pipetted into 250 ml conical flask. From each flask, a volume equal to that of toxicant solution to be added

Subash Chand, R. C. Gupta & K. L. Ghosh; Regional Research Laboratory, Bhubaneswar

Table—1

Sl. No.	Sample	Total Counts per ml.
1.	Raw water	3,100
2.	Pulp from refiners	4,600
3.	Broke beater hydro pulper	22,10,000
4.	Stock in chests	8,60,000
5.	Stock in head boxes	75,00,000
6.	White water	24,60,000

is removed aseptically. The desired amount of toxicant is then added aseptically to various flasks, bring ing the total volume back to 100 ml. Each flask is rotated immediately to mix the toxicant thoroughly with the water. The flasks are then incubated at approximately the temperature of mill system (30°C). After 6 hours of incubation, 1 ml sample from each flask is plated on nutrient agar. The intial bacterial count is determined by plating from a flask containing no toxicants. After 48 hours at 37°C, the plates are counted. Table-2 shows the data obtained, when five toxicants were evaluated for their slimicidal activity by the above method.

Discussion :

The total bacterial counts at different spots (reported in table-1) indicates point in the mill system, where growth is taking place and also measures the extent of this growth. A high count indicates that conditions are favourable for growth and if slime is not already present it may develop in the future. The five toxicants tested in the laboratory have been quite effective in bringing down the total bacterial counts of the mill white water. According to Appling and coworkers,[8] probable effective minimum dosage (PMED) of the slimicides is that which can cause a reduction of 99% in bacterial counts after 6 hours of contact. This dosage in case of the five toxicants tested in the laboratory have been **underlined** in table-2.

Conclusion :

The stock in head boxes and white water were found to be the focal points of maximum bacterial build up. Chlorine, Chloramine, Santbrite, Antimucine (NSK) and Antimucine (SPCP) all the five were found to be quite effective to control the microbial growth in the concentrations mentioned in table-2. However, their usage in the actual mill system will largely depend upon economic considerations and nature of the end product.

Table—2

Toxicant	Concentration in p. p. m.					
	0	**0.5**	**1.0**	**2.0**	**5.0**	**10.0**
Chlorine	33×10^5	55×10^4	12.4×10^4	$\mathbf{21\times10^3}$	4,000	2,000
Chloramin	33×10^5	72×10^4	19×10^4	$\mathbf{27\times10^3}$	4,000	3,000
	0	**50**	**100**	**150**	**200**	**250**
Santrobrite	17×10^6	22×10^5	$\mathbf{10\times10^4}$	1×10^4	6,000	2,000
Antimucine (NSK)	17×10^6	50×10^5	13×10^5	$\mathbf{14\times10^4}$	4×10^4	—
Antimucine (SPCP)	17×10^6	42×10^5	4×10^5	$\mathbf{16\times10^4}$	19×10^3	9×10^3

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