Bacterial Slime Control in Paper Mills with Chlorine Dioxide

Introduction

Chlorine dioxide is effective in the control of microbiological growths in paper mills under conditions unfavorable to chlorine. It is particularly effective in systems having a high pH, ammonia-nitrogen contamination, persistent slime problems, or where the microbial contamination is aggravated by contamination with vegetable or mineral oils, phenols or other high chlorine-demand producing compounds. Unlike chlorine, chlorine dioxide does not react with organic materials to form trihalomethanes.

Application Description

Some of the major operational problems in paper and paperboard production are caused by proliferation of microbiological organisms in white water and stock systems. The nutrients and temperatures normally found in white water systems encourage microorganism growth. As microorganisms grow, they form slime deposits on screens, wires and other equipment, necessitating frequent cleanup. If not removed, these deposits can dislodge and appear in the paper as spots, holes or tears. The microbes can also impart undesirable properties to the finished paper, such as unacceptably high spore counts or offensive odors. Microorganisms can also greatly accelerate the corrosion of metal surfaces and parts, leading to premature replacement of equipment.

Treatment Alternatives

Various biocides are used to control the growth of slime producing bacteria. Conventional methods of control include use of non-oxidizing biocides (antimicrobials). A biocide with good disinfection properties for the bulk whitewater may not be effective on sessile bacteria and may be ineffective at preventing the formation of slime. Many non-oxidizers lack the penetrating ability to control the biological growth within the slime layer or effectively remove it. An effective treatment program for slime control may involve both oxidizing and non-oxidizing biocides.

Chlorine Dioxide

As a broad-spectrum, oxidizing biocide, chlorine dioxide generated from sodium chlorite is effective for use in controlling microbiological growth in white water paper mill systems. Although chlorine dioxide is non-reactive with ammonia-nitrogen, it may oxidize some sheet additives such as wet strength resins or retention aids.

Since chlorine dioxide is used for potable water disinfection, it is appropriate to use this versatile disinfectant in food grade paper applications. Food grade paper is required to meet higher microbial standards than fine paper. Therefore, the cost of microbiological control is considerably higher than for fine paper. This is because it is difficult to inactivate bacterial spores, particularly the genus *Bacillus*, that survive the extreme temperatures of the dryers in the papermaking process. Chlorine dioxide has been found to be a very effective sporicide in food grade paper applications[1-2], in potable water applications[3-4], and in some food processing applications[5-6].

Unlike chlorine, chlorine dioxide is relatively non-reactive with most of the organics found in alkaline whitewater. As a result, a large portion of the chlorine dioxide fed will be available for disinfection. Thus the bacterial activity can be effectively reduced to almost any desired level by controlling the chlorine dioxide feedrate.

Advantages of Chlorine Dioxide

The use of chlorine dioxide for alkaline whitewater microbiological control is not new. Only recently have some of the additional benefits been recognized. A summary of the important benefits of chlorine dioxide is given below:

- Chlorine dioxide is a very effective slime control agent.
- Chlorine dioxide reacts rapidly and can be applied at a site immediately before the problem area, unlike many conventional antimicrobials, which are generally slow acting.
- Chlorine dioxide remains relatively non-reactive with the vast majority of organics, reducing the dose rate necessary to achieve effective control.
- Low dose rates result in typically low corrosion rates when compared to other oxidizers. In addition, minimizing or eliminating the slime layer reduces microbiologically influenced corrosion on equipment.
- The chlorite ion (chlorine dioxide byproduct) keeps working as both a bacteriostat and slime control agent, even after the chlorine dioxide has reacted.
- By effectively controlling slime growth, the frequency of boilouts can be reduced and the potential for

unscheduled downtime due to paper breaks can be minimized.
- Effectively controlling slime growth minimizes the hole count, maintaining the quality of the finished sheet.
- Odors resulting from bacterial fermentation, phenols, sulfides, or mercaptans are virtually eliminated by use of chlorine dioxide.

Feed Requirements
The required dosages will vary with water conditions, the severity of contamination, and the degree of control desired.

For control of bacterial slime, the required chlorine dioxide residual concentrations range between 0.1 and 5.0 mg/L. Chlorine dioxide may be applied either continuously or intermittently. The typical chlorine dioxide residual concentration range is 0.1 - 1.0 mg/L for continuous doses, and 0.1 - 5.0 mg/L for intermittent doses. The minimum acceptable residual concentration of chlorine dioxide is 0.1 mg/L for a minimum one-minute contact time.

Method of Feed
Chlorine dioxide is a gas produced by activating sodium chlorite with an oxidizing agent or an acid source. Sodium chlorite is converted to chlorine dioxide through a chlorine dioxide generator and applied as a dilute solution. Chlorine dioxide solutions should be applied to the processing system at a point, and in a manner, which permits adequate mixing and uniform distribution. The feed point should be well below the water level to prevent volatilization of the chlorine dioxide. Avoid co-incident feeding of chlorine dioxide with lime or powdered activated carbon.

Chlorine Dioxide Analysis
Residual chlorine dioxide concentrations must be determined by substantiated methods, which are specific for chlorine dioxide. Two suitable methods are published in *Standard Methods for the Examination of Water and Wastewater*[7]*:*

4500-ClO_2 D DPD-Glycine Method
4500-ClO_2 E Amperometric Method II

Further Information
More detailed information on sodium chlorite is available on request through the OxyChem Technical Service Department. Call or write:

Technical Service Department
OxyChem
Post Office Box 12283
Wichita, Kansas 67277-2283
800-733-1165 option #1
www.oxy.com

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