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ODOROUS FUMES FROM SULPHATE PULP MILLS

The sulphate process of cooking wood for pulp consists in treating chips with an alkaline liquor, the active components of which are caustic soda and sodium sulphide. The unbleached pulp is termed "kraft", a Swedish term meaning strong, and when the pulp is partially bleached it is termed "semi-kraft". These pulps are used extensively for wrappings, bags, envelopes, and other products where high strength is required. "Bleached sulphate" designates the fully-bleached pulp, which is used for printing, writing, and other fine papers. It also is a very strong fiber when properly made. The sulphate pulps of all kinds are rapidly supplanting the sulphite fibers. The sulphate process is particularly suited to the pulping of pine wood.

During the cooking process, and in the recovery of chemicals; large quantities of gases and volatile compounds are formed. Little is known about the toxicity of these substances, but no instances of injurious effects on health are recorded. However, the substances have extremely offensive odors, and if they are permitted to escape into the atmosphere, even in small quantities, the mill will be a nuisance in the community.

The malodorous gases are mainly mercaptans and alkyl sulphides which are formed by combination of sulphur with certain organic constituents of the wood. They are heavier than air, and are obnoxious in extremely low concentrations; hence they are often offensive at great distances from the mill. Under some atmospheric conditions, the odors may be plainly noticeable at a distance of 10 miles or more. For many years the odors characteristic of kraft pulp manufacture were considered to be necessary evils, and mills were forced to locate far from population centers. However, improvement in equipment for the recovery of chemicals and the destruction of odorous substances has made it possible to confine the odors to an occasional accidental escape of gas, and plants are now located in cities and villages.

The odors originate in the digesters during the cooking and in the recovery plants, and there are numerous points where they may escape to the atmosphere. Odorous gases may escape when the digester is vented to control the pressure, or when the

digester contents are ejected at the completion of a cook. Vapors and gases escaping from the waste liquor during collection, storage, or evaporation, or from wash waters and condensates, will be offensive also. Satisfactory elimination of the odor nuisance requires complete control at all points.

The method of control most successful in practice consists in burning all black liquor and noncondensable gases in recovery furnaces in which residual chemicals are calcined for re-use, and the gases oxidized and deordorized. Wash waters and condensates containing dissolved gases are utilized in the mill as they become a source of odors if discharged as waste or otherwise exposed to the atmosphere, unless first treated to destroy the odors.

In operation, the spent or black liquor accompanies the pulp into the diffuser or blow-pit when a digester is discharged. The liquor is drained off, strained to remove the fiber, and collected in storage tanks. From here it is drawn to the recovery plant where it is concentrated to high density by evaporation. It is then injected into the combustion chamber of a furnace where the evaporation is completed, the organic solids and evolved gases are burned and deodorized, and the sodium salts reduced for use in fresh liquor.

The vapors from the digester and from the black liquor evaporation are condensed. The condensates carry large quantities of dissolved gases, and should not be discharged as waste. They may be used for the first washing of pulp or to make up fresh liquor. The water from the first washing of the pulp likewise becomes heavily charged with odorous gases, and should be used in fresh liquor make-up or for other purposes that will destroy the odors.

The noncondensable gases from the digester blow-off and the digester relief condenser, also the gases from the diffuser or blow-pit vents, black liquor tank vents and safety valves in the digester blow-off line, should all be collected and fed into the combustion chamber of the recovery furnace where they will be destroyed along with the black liquor odors. Water used in the scrubbers of recovery furnaces may be recirculated until it reaches sufficient density to go to the black liquor tank. Odors can be removed from the gases by chemical treatment, and this method has been investigated by the National Bureau of Standards in a branch laboratory at Tuscaloosa, Alabama. It was found that

the odors can be destroyed with chlorine; however, the method has not been found commercially feasible in this country. Results of the study are given in the article by Gordon and Creitz, reference to which appears at the end of this article.

The stationery recovery furnace destroys the odors of gases and black liquor when properly operated. However, improper combustion may be caused by introducing the black liquor before the proper temperature is reached by preheating on starting up, by introducing insufficiently concentrated liquor, or by crowding the furnace. Improper combustion will allow sulphur compounds to go through the furnace unburned and to be discharged from the stack without destroying the odors. Hence, proper control of the recovery furnace is essential.

In general, the gases from the process are so offensive that the escape of very slight amounts into the atmosphere will result in complaints, and one weak spot in the most elaborate odor-control system will render it ineffective. Also it must be remembered that, even with equipment of the most advanced design, there may be times when circumstances of plant operation and atmospheric conditions may combine to create some objectionable odors.

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