

operated above its rated capacity, a widespread industry practice. Black liquor oxidation even if employed universally will not completely solve the industry's odor problem. To reduce or eliminate odorous emissions either a satisfactory method of scrubbing the vent gases from the recovery furnace and direct-contact evaporators must be developed or a process change must be introduced to prevent the formation of odorous compounds.

Particulate emissions from black liquor recovery furnaces are controlled by two methods—scrubbers, using black liquor, or electrostatic precipitation. Scrubbing, in practice, has been only 85 percent effective in particulate removal. Electrostatic precipitation used in the industry is usually 85 to 95 percent effective in particulate removal. Neither method will effectively reduce odors. Designs are available by both techniques to achieve particulate removal in excess of 99 percent efficiency, but at increased cost. For example, on a 550 ton per day mill a 90 percent efficient precipitator will cost about \$230,000 or only about one-tenth of the installed cost of the recovery furnace. To control particulate at the 99 percent level, the precipitator might cost about \$300,000 and its cost might increase to about \$340,000 for 99.5 percent control.

The industry trend is toward larger and larger plants. While plants with a capacity of 200 tons per day were considered large in the past, new plants are being designed to produce 1,200 tons per day. The need for higher air pollution collection efficiencies is therefore apparent.

Generally speaking, new methods for controlling air pollutants have not been adopted at a rate comparable to that with which the industry has expanded. Even in the case of newly installed kraft mills which were said to incorporate all the latest means for air pollution control, there have been numerous public complaints about odors from the mills.

The sixth and last industry that I would like to discuss briefly, Mr. Chairman, is the organic chemicals industry. The various industrial groupings in this category include the manufacturers of synthetic rubber, rubber-processing compounds, synthetic fibers, elastomers, resins, and intermediate chemicals such as phenols and anhydrides. Pollutants from these industries consist generally of dusts, mists and a variety of odorous organic vapors associated with the materials of the process. Control of these pollutants is effected by the use of gas scrubbers, adsorption on activated carbon, catalytic oxidation or incineration. An exception is the carbon black industry. Here the pollutants are fine particles and the principal means of collection are cyclones followed by fabric filters and electrostatic precipitators.

Our technology for controlling organic emissions is not as well developed as emission control in other areas. Water scrubbing frequently does not reduce odors to acceptable levels. Some success has been achieved by using a scrubbing solution that reacts with the organics to form odorless products. Catalytic oxidation may fail because of poisoning of the catalyst by components of the gas stream. Direct flame afterburners have, in many cases, been the only method which successfully destroy organic vapors. These afterburners are not only costly to operate because of high fuel use rates but also add to emissions of nitrogen oxides.

Odors are hard to destroy because certain chemicals have extremely low threshold levels of odor detection. Improved plant maintenance and process changes are effective in reducing some odor problems.

A typical industrial problem is the manufacture of paint and varnish. The primary pollutants are aldehydes and organic sulfur compounds which are given off during the cooking process. The most commonly used control method, although not the most effective, is scrubbing with a liquid such as water, oil, or alkaline or acid solution. The most effective methods are the use of direct flame and catalytic afterburners to completely oxidize the effluent vapors. Removal efficiencies of 85 to 98 percent are reported for scrubbing and 100 percent for incineration.

The cost of emission control equipment for the organic chemical industry is not as great as that for some other industries. Scrubbing equipment, which is the most common means of control, costs one-tenth as much as high efficiency collectors such as electrostatic precipitators and fabric filters as are required by the metals and minerals industry. The organic chemical industry has had an average production growth rate of 10 percent per year for the last 4 years and sales of \$8 billion for 1964. This represents about one-fourth of the total chemical and allied products industry. The chemical industry capital spending was esti-