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ENVIRONMENTAL & PRODUCTIVITY TECHNOLOGY INNOVATION FOR THE FOOD MANUFACTURING INDUSTRY

NEEDS STATEMENT TITLE: VOLATILE ORGANIC COMPOUND (VOC) CONTROL IN THE FOOD PROCESSING INDUSTRY – ET-5-A-(9)

DATE: JUNE 18, 1996

TECHNOLOGY REQUIRED

The food processing industry seeks technology to manage and control VOCs. Included in the required information are capital and operating costs, reliability and stability of processes and operations, start-up characteristics and knowledge of the response to transient loadings. The information should be contaminant specific in terms of polar, nonpolar, and aerosol versus completely volatilized materials. Potential for odor control and for removal of photoreactive compounds is required. Particular emphasis should be placed on biological treatment processes and their potential for meeting future emission standards.

BACKGROUND

Volatile organic compounds (VOCs) and other volatile or gaseous pollutants such as H_2S and No_x are common emissions from food processing operations. Emissions result from fermentation, cooking, clean-up, disinfection, and other steps in food production. Compounds of concern range from alcohols and aldehydes produced in fermentation (bakeries, breweries, wineries) to fats, oils, and greases emitted from cooking operations, and chlorinated compounds produced in disinfection. Contaminant concentrations are generally low, ranging from less than 100 ppm_v to a few 1000 ppm_v.

Three types of problem are associated with VOC production: toxicity, odors, and air pollution associated with photoreactive compounds. Toxicity is generally not a problem in the food processing industry; that is, air emissions are generally non-toxic, even in indoor environments. Odors are significant problems and include a wide range of compounds as causes. Unfortunately, odors are often associated with very low contaminant concentrations (ppb_v in the case of mercaptans). Photoreactive compound emissions, such as alcohols, are regulated by local, state, and Federal agencies.

PROBLEM AND IMPACT OF SOLUTION

The principal problems associated with treating VOC emissions from food processing are the result of the low concentrations. Odor elimination requires essentially complete removal of

the offending compounds. Removal of photoreactive compounds from low concentration streams is generally quite expensive. Contaminant concentrations are generally highly variable with time and treatment processes must be able to provide a high degree of treatment over a significant concentration range while meeting emission standards under time variant loadings.

Many food processing operations are seasonal and capital investment in control devices presents a significant problem. Since many food processors are small, capital investment is a major problem. Rapid start-up and simplicity of operation are important factors in a successful control method for both seasonal and small processors.

STATE OF THE ART

Currently available VOC control methods include:

1. *Granular activated carbon (GAC) adsorption.* Adsorption on GAC is generally a straightforward application. Carbon canisters can be purchased and "plugged" into emission systems quite easily. Operation of GAC systems does not require sophisticated staff. The method works best on non-polar compounds (hence sorption in not particularly effective for alcohol) and dry gas streams are preferable. GAC adsorption is an equilibrium process and VOCs may desorb during periods of low contaminant concentration. An adsorption capacity exists for each compound and eventually the GAC must be regenerated or replaced.

2. *Scrubbing.* In scrubbing processes contaminated air is contacted with water sprays in a scrubbing chamber. The process is very good for hydrophilic compounds (e.g. alcohols, sulfides) and relatively poor for hydrophobic compounds. Efficiency of scrubbing is dependent on concentrations and spray characteristics as well as the contaminants involved. A wastewater is produced which will require management. Scrubbing systems are simple to operate and reasonably inexpensive as long as water requirements are low.

3. *Combustion.* Emissions from food processing operations do not contain enough combustible material to burn without the addition of fuel. Destruction of VOCs by combustion can sometimes be accomplished by using the process off-gases as boiler feed air. Construction and operation of a combustion process specifically for the off-gases would generally be prohibitive.

4. *Catalytic oxidation.* Oxidation of combustible compounds in off-gases can be accomplished by passing the air over a catalyst (as in automobile exhausts). Catalytic catalytic oxidation are similar to GAC adsorption but the majority of the cost is for capital investment into the equipment.

5. *Vapor phase bioreactors.* Biofilters and biotrickling filters are used widely in Europe for treating air streams with low concentrations. The systems are relatively inexpensive and can generally meet emission requirements for compounds produced in food processing operations. Vapor phase bioreactors require careful operation, although the systems are not highly sophisticated and operators do not require extensive training. Reliability of vapor phase bioreactors over long periods of operation and under transient loading conditions has not been established.

TECHNOLOGY SPECIFICATIONS AND CONSTRAINTS

Treatment processes must be capable of removing more than 90 percent of the VOCs in contaminated air streams. Where odors are an issue, processes must be capable of reducing odors to an acceptable level based on local standards. Process stability and capability to produce acceptable product air under significant transient loadings is essential. Start-up characteristics after long down periods (such as occur in seasonal industries) and short down periods (overnight and weekends) are important factors in process selection. Minimization of secondary waste production is highly desirable.

The Needs Statements have been prepared by university and industry experts under the direction of the National Food Processors Association's technical staff according to the outline and format prescribed by the systems implementer, R. J. Philips & Associates, Inc.

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