TRC

June 30, 2006

Mr. Michael Laurent
Omya Inc., Verpol Plant
Florence, Vermont

Dear Mr. Laurent:

Based on recent studies last fall and this spring at Omya Inc., Florence Vermont, certain East Plant operations have been shown to be an occasional source of wax-like odors in the community. The emissions testing, odor panel testing, and dispersion modeling indicate that increased stack height does not provide a complete solution. In view of the study results, add-on control or process modifications will be necessary to address the problem. The purpose of this report is to investigate possible odor and air emission control options.

The Nature of the Odor Problem

The total exhaust gas flow from the dryers is about 28,000 actual cubic feet per minute (ACFM) at a temperature of about 200 ^{o}F. Initial testing of the East Plant dryers revealed that the combined concentration of all odor-causing compounds in the exhaust gas ranges up to 21 parts per million by volume (ppmv). Such very dilute contaminant exhaust streams are expensive and technically difficult to control. This is due to two factors: 1) the need to treat the entire exhaust gas volume, and 2) the very low driving force to absorb or adsorb the compound(s).

One way of looking at the problem is that at 21 ppmv, less than 1.8 cubic feet of odor-causing compound gases within the total exhaust flow are responsible for offsite odors. Nevertheless, such odors must be addressed.

Analysis of Technical Feasibility of Options

There are several control techniques that are commonly used to remove gaseous contaminants from exhaust streams that include:

- Thermal oxidation
- Wet scrubbing
- Carbon adsorption
- Biofiltration
- Process Change

Each of these has been evaluated for the East Plant dryers.

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Thermal Oxidation

Thermal oxidation is a technique where exhaust is heated to a high temperature and held for a residence time of approximately 1 second within a refractory-lined combustion chamber. Typically, temperatures of 1400 to 1600 °F are required to attain 98% to 99% destruction efficiency of gaseous organic compounds. This method can also serve the dual function of incineration of any particulate organic matter such as stearic acid that may exist in dryer exhaust. One disadvantage of this technique is that the entire gas stream must be heated to the ignition temperature for effective performance. It is, however, a highly reliable technique. A second disadvantage is that a few compounds that contain silicon such as siloxanes, sometimes used as lubricants, can create undesirable organo-silicate solids that deposit on the interior surfaces of the equipment. Formation of these organosilicates are of a nuisance nature, and often require equipment cleaning at frequent intervals.

The installed cost of a thermal oxidizer sized to treat 28,000 acfm at 200 °F is on the order of $1,000,000. Thermal oxidation equipment is designed to be highly thermal efficient. However, even at 95% heat recovery from the exhaust by using waste heat to preheat incoming gases, the estimated annual fuel cost to heat 28,000 acfm at 200 °F to 1600 °F is on the order of $150,000 per year at a nominal current fuel cost of $14 per million Btu of heat input. Assuming 5 days a week operation, 24 hours per day, the cost effectiveness, in units of measure commonly accepted by EPA and state air pollution agencies, is on the order of $50,000 per ton of odor causing contaminant -- which is exorbitant. Operation of thermal oxidation equipment creates secondary pollutants which include nitrogen oxides, carbon monoxide, carbon dioxide, and others.

Wet Scrubbing

Many of the compounds identified in the study are aldehydes which are soluble in water; however, the very low concentrations in the gas lead to equilibrium concentrations in absorption water which are similarly low. Normally, scrubbing is performed with a recycled water tank in a system where contaminants build up over time and are either removed or stripped to regenerate the absorption solution. Furthermore, the driving force for transfer of the contaminant from the gas to the liquid is proportional to the concentration in the gas and liquid streams. The only chance to remove appreciable contaminant is to use once-through water (as opposed to water from a recycle tank) in a packed column absorber where sufficient contact area between gas and liquid is available.

A defining operating parameter in wet scrubbing is the liquid to gas ratio where the L/G is expressed in moles of liquid per mole of gas. At a low L/G of 1, a water flow of 150 gallons per minute would be required for 28,000 acfm. This flow of 0.2 million gallons per day would require both a new high-yielding water source and treatment in a wastewater treatment plant. However, such a water source currently is not available and may be impossible to develop, and a wastewater treatment plant currently does not exist in or serve the area where the East Plant is located.

Carbon Adsorption

Activated carbon is used in air pollution control where there is a desire to recover and reuse the adsorbate. Carbon can be regenerated by use of steam or heated air stripping followed by recovery via condensation of the solvent/water mixture. Carbon adsorption is not effective if the adsorbate is highly volatile or polar. At low concentrations (below 200 ppmv) carbon is not a viable means of control. Thus the Omya exhaust, with concentrations on the order of 20 ppmv, is not suitable for control using this method.

Biofiltration

In this control technique, biologically active materials are used in a loose bed of materials wherein the contaminant laden gas stream is allowed to contact the moist media covered with biological agents. Biofilter beds containing compost or other biological material are typically large with residence times of the polluted gas stream between 30 and 100 seconds. The microbe containing beds feed on the organic material in the exhaust and have typical control efficiencies of 70 to 90% or more.

The Omya dryer exhaust at 200 ^{o}F is above the maximum allowable temperature for biofilters of 105 ^{o}F. Biofilters have a need for stable conditions of high humidity, constant exhaust flow, and neutral pH. With the dryer emissions at 200 ^{o}F, a quenching water scrubber to cool the gas stream or other humidification technique prior to the biofilter is mandatory. In some biofilter applications, liquids are trickled downward over a bed of packing in a manner similar to that used in water treatment applications. Such trickling filters use a recycle tank in conjunction with the packed bed to remove odorous compounds. Vertical chambers with water sprays take the concept one step further combining the wet scrubber control technique with the biofilter approach to provide effective control in some designs.

Biofilters are in general less expensive than other control methods. They have few moving parts other than the exhaust fan that moves the exhaust through the bed. Generally they must operate continuously and lose effectiveness with non-use. A period of recovery is often required when the biofilter is taken off-line due to process outage.

Process Changes

Reformulation, equipment changes, process condition changes, or other in-process controls are often used to reduce emissions. Stearic acid is a component of the process that appears to be the source of odor and air emission problems. It is believed that partial decomposition of this long chain organic acid forms the odorous aldehydes in the dryer. All aldehydes have low odor thresholds in addition to the low odor threshold for stearic acid itself. Unless another process material additive is identified to replace stearic acid, odor causing compounds will persist at Omya from the current process.

Process changes that reduce volatility by allowing operation at lower temperatures will likely reduce odorous emissions.

Conclusions

Odor and air emission control at the East Plant requires reduction in the rate of odor and air emissions as opposed to simply the use of taller stacks for improved dispersion. Control by thermal oxidation is possible but would be prohibitively expensive. Wet scrubbing and carbon adsorption are not viable due to the limiting factors described previously. Control using a biofilter is generally possibly, although maintaining stable operating conditions for the biofilter beds during routine shutdowns, and maintaining optimum bed temperatures, would present serious challenges and likely be limiting factors.

Process changes to reduce operating temperatures, or otherwise prevent the formation of undesirable compounds in the exhaust, is the best practical solution to the odor and air emission issues from the East Plant. Recent testing of a modified process configuration indicates possible lower emission rates, however, the actual emission rate data are not yet available as of this date. Please call me if you have any questions.

Sincerely,
TRC ENVIRONMENTAL CORPORATION

Mark M. Hultman, P.E.
Principal Consulting Engineer

cc: Sam Cha, TRC