AN INSTRUMENTAL SYSTEM FOR THE MONITORING OF VINYL CHLORIDE MONOMER IN PLANT AND LABORATORY WORK ENVIRONMENTS

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January 1974

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Introduction

Within the past several years there has developed a growing awareness of the need to do continuous or sequential sample monitoring of air quality in both laboratory and production work areas. Significant factors contributing to our increased knowledge relating to air quality in polymerization buildings in the PVC industry include the development of suitable instrumentation for the analysis of contaminants and the implementation of these methods, initially on a batch sampling basis. The development of much improved monitoring systems has lead to the ability to do continuous or sequential monitoring (as opposed to batch sampling) by interfacing an analytical instrument with an automatic sampling system. Additionally, the response signal from the analytical instrument now can be feed to a programmable calculator or minicomputer to provide new reporting capabilities such as hourly and shift average concentration levels as well as an instantaneous display and recording of concentration levels at multiple locations.

These much improved sample handling, analytical and data processing capabilities have revealed that the analysis of air quality based on infrequent, batch samples is grossly inadequate. It is also now apparent that even the most advanced instrumental system is not totally adequate because of its limitations in monitoring only from specific, fixed locations, whereas the monitoring needs may frequently be shifted from one location to another. The use of a fixed monitoring system, supplemented by the frequent use of easily portable analyzers having equivalent capabilities, is now recognized as the minimum requirements for both monitoring and maintaining good air quality in polymerization work areas.

As a result of this improved ability to make air quality measurements there has also developed an increased awareness of the many complexities involved in the maintenance of good air quality in an enclosed working area. Good ventilation, the rigid exclusion of leaks and the institution of improved manufacturing procedures are only a part of the practices that must be adhered to. Equally important is the ability to provide early detection and to take immediate corrective action when contaminant levels exceed the criteria established for employee exposure.

Obviously, a monitoring system must therefore be designed to meet the requirements of specific work areas. Preliminary studies must be made to determine excursion limits (maximum and minimum concentrations) of air contaminants and a number of analytical methods must be considered or tested to provide the required measurements. Another important factor is the frequency of sampling and analysis required to provide early warning of high concentration levels and a suitable history of employee exposure. Equally important in the planning stage is proper consideration of data handling since continuous or rapid sequential monitoring from multiple sample locations can produce such a large quantity of data that some means of automated data acquisition, summation, averaging and report writing must be included as a part of the total system.

Instrumental and System Requirements

An instrumental system for the monitoring of vinyl chloride monomer (VCM) in a process or laboratory work area should have the following capabilities or characteristics;

* One ppm detection capabilities (or better),
* Rapid response to changes in concentration levels,
* Linear and reproducible response over a wide concentration range (0 - 1000 ppm),
* Require a minimum of operator attention and maintenance,
* Have the capability of sampling at multiple, remote locations.
* Be compatible with a variety of sampling requirements and data handling methods, such as interfacing to a multi-point recorder, programmable calculator or minicomputer.

Other desirable characteristics of this system should include low or moderate cost, the employment of simple, well accepted concepts and that the hardware and associated electronic equipment be compatible with existing operating and maintenance capabilities in our production plants. It also would be desirable that the instrumentation be of a type currently available from several instrument manufacturers.

Instrument Selection and Evaluation

Data obtained through the analysis of batch samples (using gas chromatography) and survey analyses (using a portable organic vapor analyzer) are sufficient to suggest that two different types of instrumental capabilities are required to meet all of the criteria for effective monitoring and rapid identification of emission sources. The utility of the portable organic vapor analyzer is already apparent in its ability to rapidly and very specifically identify small leaks in processing equipment. It was an early conclusion that an effective total system must include the capability to monitor with both fixed and portable analyzers. The fixed analyzer should monitor a

sufficient number of sample locations in a building so as to provide a continuous record of concentration levels and equally important provide early detection of concentrations exceeding desired levels. When high VCM levels occurred, the portable analyzer would then be employed to more rapidly identify the source and provide the supplemental capabilities needed for immediate corrective action.

The screening of methods having potential for meeting all of the required performance criteria resulted in a select list of instruments for further testing in a production plant environment:

Table 1

Survey Instruments (Portable)	Monitoring Instruments (Fixed)
1. Gas Chromatograph	1. Gas Chromatograph
2. Infrared w/20m gas cell	2. Combustion-Conductivity
3. Catalytic oxidation	3. Infrared w/20m cell
4. Flame Ionization*	4. Flame Ionization*

*Organic Vapor Analyzer (OVA)

Obviously, the above list includes a number of instruments that are now widely used for the monitoring of air quality. Some of these methods (infrared and gas chromatography) have specific component identifying capabilities and some (catalytic oxidation, flame ionization and combustion-conductivity) give a total response to hydrocarbons or halogens. In the early stages of in-plant testing of these methods it soon became apparent that in a majority of PVC polymerization work areas, specific component identification was not required because the presence of atmospheric contaminants, other than VCM, was of little or no concern. Even in those areas where two or more components are present the