SPECIALTY VINYL CHLORIDE RESIN PROCESSES

EFFECTS OF GOVERNMENTAL REGULATIONS

R. N. WHEELER, JR.

September 1, 1976

3. Reactor product changeovers were made without equipment cleanup; thus, any VCM contained in the reactor was reacted into a non-PVC latex. This technique requires careful study and product selection to maintain overall product quality.

4. Emissions during monomer unloading were reduced by inert gas purging of the unloading hoses to the supplier's truck and using dry disconnect couplings. These couplings contain check valves that close automatically when the hose is disconnected; thus, the VCM is held in the hose rather than emitted to the air. This is a feasible solution when small hoses can be used.

Items which are troublesome under the OSHA standard and will be affected by the proposed EPA standard are:

1. All rotary pumps handling VCM or mixtures of VCM will have to be equipped with double mechanical seals instead of their present single seals. No measureable change in VCM emissions is expected though, theoretically, emissions caused by seal failure are lower with double seals.

2. Revision of reciprocating compressor and pump packing glands in a manner acceptable to EPA. As mentioned earlier, this portion of the proposed EPA standard is unclear. No measureable change in emissions is expected.

3. VCM emissions caused by control of equipment maintenance for items in monomer service is awaiting promulgation of the EPA standard. Since only the monomer storage tank and piping are involved, the investment will be minimal.

The effect of the VCM health and air emission regulations on latex plants has been to tax the engineers ingenuity to the utmost. Many of the controls used make full utilization of available facilities and knowledge. This in one advantage of the program discussed earlier in that investment for control equipment is optimized.

CONTINUOUS BULK POLYMERIZATION - UCC Nonsolvent Process

Continuous bulk polymerization of vinyl chloride produces a fine, very porous resin particle containing no surfactants, suspending aids or other extractibl material. The porous fine particle gives up residual vinyl chloride monomer very readily; thus, these resins as sold contain 0 to 10 ppm vinyl chloride monomer. The resins find use in plastisols, slush and powder coatings and in medical devices such as blood bags.

The flow diagram (Figure III) shows four steps: polymerization, monomer stripping, dewatering and drying. The process operates on the principle that polyvinyl chloride is insoluble in vinyl chloride. Vinyl chloride, catalyst and comonomer are fed to an agitated reactor; as the monomer polymerizes the polymer precipitates so that the reaction mass is a slurry of resin suspended in monomer. Some heat of reaction is removed by jacket cooling, but most is removed by evaporation of monomer. Resin slurry is removed to the stripper where it contacts hot water driving off the unconverted monomer and yielding a resin water slurry. This is vacuum stripped to remove more monomer. The resin is dewatered and dried in an air drier.

The major problem contributing to emissions is equipment fouling with resin deposits. These deposits must be removed manually from the reactor and accessory pipelines. Reactor cleaning is required about every five days.

The continuous bulk polymerization is relatively old in terms of technology and plant. The fact that it is still operating is indicative of the unique properties of its resins. Age has, however, not prevented progress toward meeting the current and proposed regulations. Table IX shows the change in personal exposure from 1973 to 1976.

TABLE IX

CONTINUOUS BULK PVC PERSONAL VCM EXPOSURE

Operator	Year 1973	Year 1976
Number 1	7.9 ppm	0.5 ppm
Number 2	3.6 ppm	0.05 ppm
Number 3	7.95 ppm	0.43 ppm
Number 4	2.4 ppm	0.14 ppm
Number 5	16.6 ppm	0.14 ppm

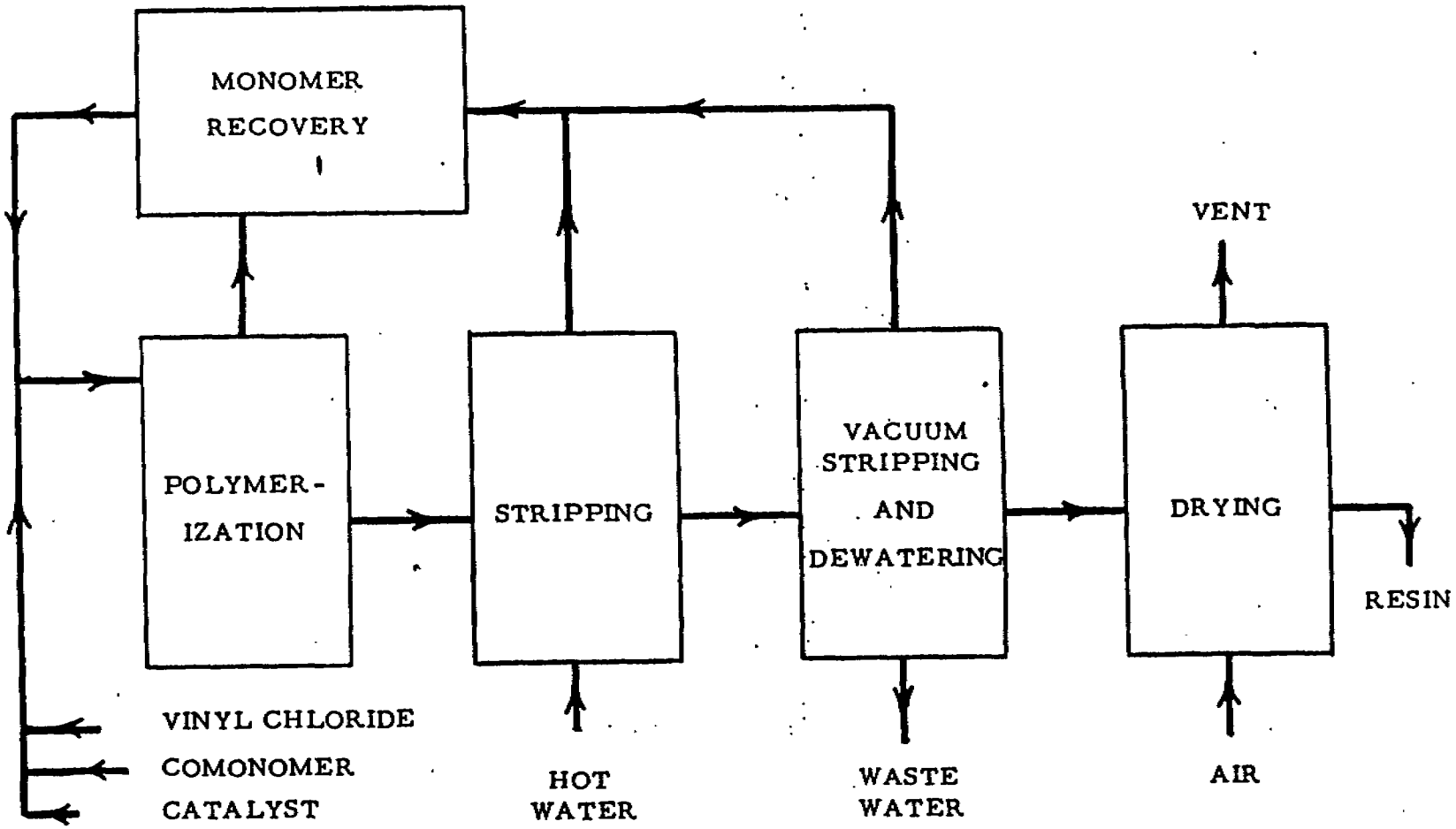
The low TWA exposures for 1976 raise a question. The OSHA standard states that TWA exposures of less than 0.5 ppm require no control action yet on the day these measurements were made four out of the five men wore a respirator for a part of the day. The plant, as a safety policy, chooses to avoid employee exposure if there is a possibility of an emission.

The continuous bulk polymerization plant is a part of a larger suspension resin operation; therefore, no specific data on ambient air emissions is available.

Operational changes caused by the regulations are as follows:

FIGURE 2

CONTINUOUS BULK VINYL RESIN PROCESS



1. Solvent scrubbing of the monomer recovery system vent reduced the VCM concentration of this stream to less than 0.5%. The vent from this system was then incinerated in the local steam power plant. The solvent scrubbing system operates at 100 psi cleaning 400 pounds of vent gas per hour with methyl ethyl ketone.

2. The process control rooms where the operators spend most of their time were pressurized and ventilated with air from a remote location. When an operator has to go to a particular plant location he checks the VCM monitor and uses a respirator if the need is indicated.

3. All rotary pumps in vinyl chloride service were equipped with double mechanical seals as required by the proposed EPA standard. In this plant there was a decrease in the work space air concentration as a result of the change from packing and single seals to double seals.

Process development and new investment remain to be done in this process to achieve full compliance with the OSHA standard and the proposed EPA standard. Major items for further work are:

1. Improved resin slurry stripping. The present two-stage continuous system is barely meeting the minimum EPA limit for stripping. The monomer left in the very porous resin particle readily leaves the resin in the drier; thus, the resin leaves the process in the 0 to 10 ppm RVCM range. Improved stripping would reduce the dried resin to 0 ppm RVCM and would reduce potential employee VCM exposure in the drying area. The number of stripping stages and operating conditions are not yet fully determined.

2. Improved monomer recovery. Replacement of the existing reciprocating compressors with rotary units is in the engineering stage. This change will be a part of an overall revision of the recovered monomer system to provide more surge capacity, to reduce safety hazards caused by vacuum operation, to reduce vinyl chloride emissions and to reduce the energy requirements of the process. This low conversion process has a major portion of its investment in monomer recovery and handling equipment; thus, this could be said to be a large project.

3. Reactor agitator stuffing box revision. The proposed EPA standard requires that agitator packing consist of double mechanical seals with a pressurized sealing fluid between the seals. Since the reacting material has the potential for complete conversion

to polymer, mechanical seals quickly become inoperative. The present system uses dual sets of mechanical packing with a sealing fluid which hopefully EPA will accept as equivalent.

4. Equipment maintenance. As in the preceding discussion of other processes the application of EPA's proposed regulation to maintenance of equipment is not wholly clear; thus, a problem of interpretation and application of the regulation remains.

As in the solvent and latex processes the continuous bulk process has many other smaller emission problems that have been or are being corrected.

This discussion of the effect of governmental regulations on the specialty PVC processes is more of a brief progress report than it is a technical presentation. The industry has many problems that are similar to the larger segment of the PVC and it also has some problems that are peculiar to its operations. A great deal of progress has been made, but the end is not yet in sight.

In summary, the specialty vinyl chloride resin area has attempted to respond to the need for public and worker safety as well as to the resulting governmental regulations. The key factors in this response have been and will continue to be:

1. Availability of technical and financial resources.

2. Personal commitment on the part of the people involved.

3. Aid and cooperation of the regulatory bodies.

With these tools almost any problem including vinyl chloride control can be overcome with a lot of hard work.