

## THE PREVENTION OF PVC REACTOR FOULING

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B. F. Goodrich is the largest PVC producer in the U.S.A. As such, we have been very involved in the vinyl chloride toxicological, manufacturing and regulatory actions during the last five years. Simultaneously with our disclosure of the relationship between vinyl chloride monomer and angiosarcoma in humans, B. F. Goodrich mounted a major program on vinyl chloride monomer containment to eliminate exposure to our employees and our customers and to minimize emissions to the atmosphere. I would like to report today on two technology developments which were an outgrowth of this program: The prevention of reactor fouling and later reducing vinyl chloride monomer in PVC resins.

Opening a PVC polymerization reactor has been one major source of vinyl chloride exposure or emissions. The openings are required primarily to remove polymer buildup. Reactor fouling or buildup historically has been a problem in PVC polymerization. There are basically two possible approaches to this problem:

1. Elimination of reactor fouling
2. Removal of the buildup - either mechanically or chemically

We investigated both of these approaches. In fact, in the 1960's the industry encountered problems with acro-osteolysis, a deterioration of the bones in the fingers of some of the workers who entered to clean PVC reactors after each batch. At that time, we developed the hydraulic reactor cleaning (HRC) technology which uses a high pressure (4000-6000 psi) water jet. The nozzle is inserted into the reactor and programmed to rotate so that it cleans the entire reactor surface. This approach was very successful. Vessel entry was reduced to once every 25-30 charges using the HRC and the equipment is still used in some of our PVC reactors today.

We also looked at chemical cleaning but found this added several additional processing steps and also required handling and treating of another chemical or solvent. Therefore, we turned our attention to the prevention of reactor buildup. There is a myriad of approaches to buildup prevention as indicated by the heavy increases in the patent literature today and over the last several years. Some parameters to be considered are polymerization recipe and raw material, operating procedures and even reactor design. Significant attention was addressed toward understanding the mechanism of buildup formations, i.e., how and why it occurs so we could more productively address its prevention. I won't attempt to go into these studies today. Suffice it to say after addressing all of these concerns, we have developed and implemented

commercially a system we believe is both simple and effective. As you can see from Figure 1, the system outwardly is very simple, consisting only of a chemical feed tank, a pump and a feed nozzle used in conjunction with existing reactors in which vinyl chloride monomer is polymerized to PVC. The key to the system is the coating solution and method of application. The process consists of carefully water rinsing the loose resin from the reactor interior to the slurry stripping system after each polymerization and then spraying a coating solution onto all the internal surfaces of the vessel.

These operations can be performed simply with a hose through an open manway or more preferably by spraying through a permanently mounted nozzle inside the reactor. The latter approach permits ease of automation and operating the reactor in a completely closed mode.

When this procedure is followed after every polymerization charge, reactor fouling is eliminated and significant reduction of vinyl chloride emissions can be attained. Our results to date have shown we can run well in excess of 500 polymerization batches without cleaning reactors. We have also run in excess of 50 batches without opening the polymerizer. The technique eliminates vinyl chloride emissions and operator exposure due to reactor downtime, reduces labor, and improves raw material efficiency. Reactor entry is now required only for normal maintenance.

The benefits of this technology then are:

1. Closed reactor operation - entry only for normal maintenance
2. Reduction in worker exposure to VCM.
3. Reduction in VCM emissions to the atmosphere.
4. Reduction in reactor downtime due to cleaning and a result increase in productivity.
5. Savings in labor.
6. Polymer buildup lost as scrap is eliminated.
7. Reduction of rupture disc changes due to polymer buildup.
8. Constant and maximum process side heat transfer coefficient in the reactor.

B.F. Goodrich presently uses this technology in all of its PVC plants - both foreign and domestic. In addition, the technology is available for license and has been licensed here in the U.S. and overseas.

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# VCM Reduction Clean Reactor System

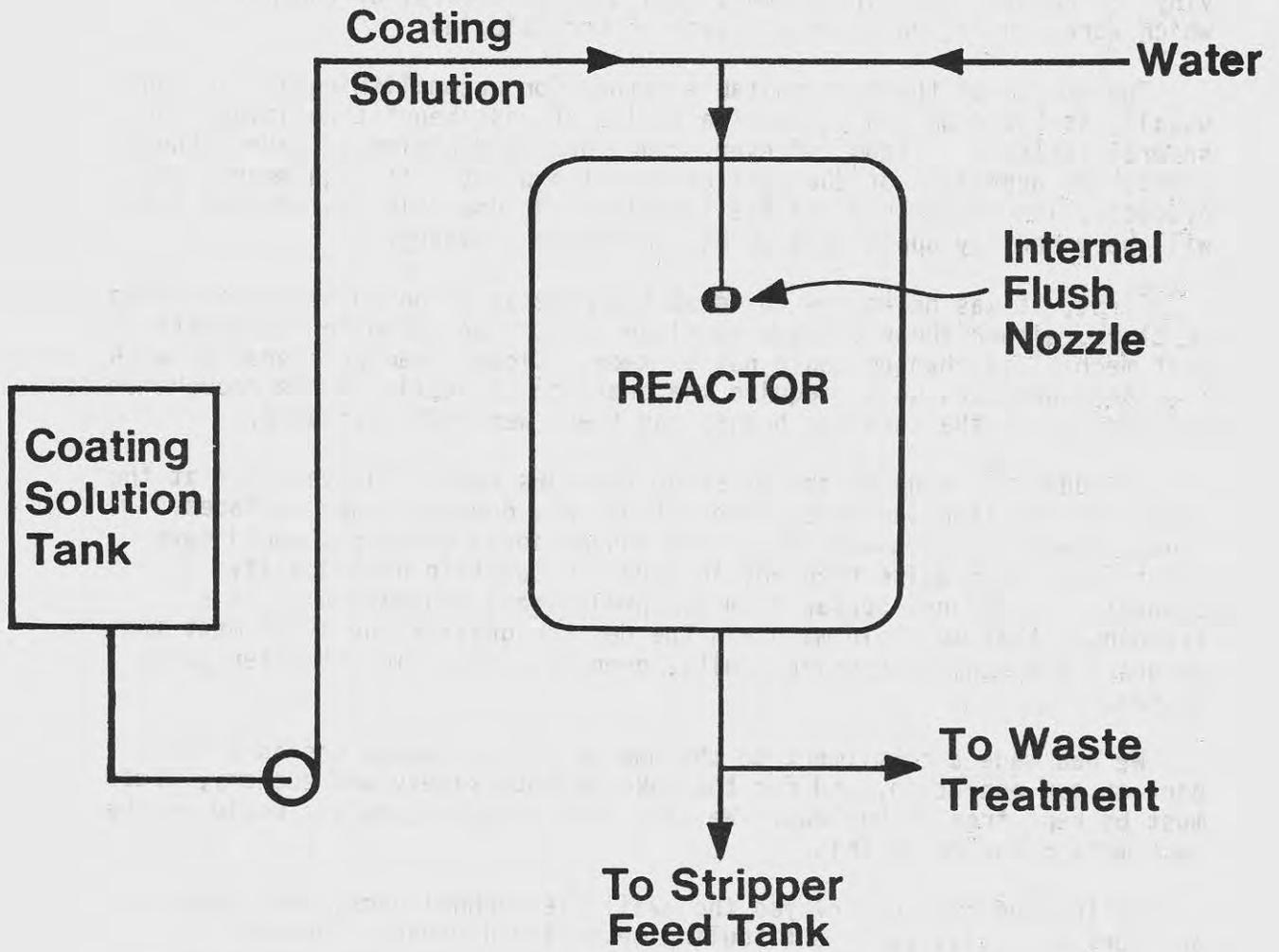


Figure 1.

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Public Health Service  
Centers for Disease Control  
National Institute for Occupational Safety and Health

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