

NOTES RE: VISIT TO DIAMOND SHAMROCK PLANT  
IN  
HOUSTON, TEXAS - FERMENTA PLANT

Accompanied by: Jim Amedeo, Plant Superintendent  
Ben Willemstyn, Pall Corporation, Long Is., N.Y.  
Nick Figgess, Fenco, Toronto  
Kent Morton, Giant, Yellowknife Division

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Purpose was to inspect the installation and operation of high temperature sintered (porous) metal filters in an application where they are used to separate solids from a gas stream at fine particle sizes.

We inspected the installation of two such arrangements. The first was for the removal of solid catalyst from a toxic stream of herbicide/pesticide under reducing conditions at moderate temperature; the second was a high temperature reoxidation of the catalyst at 450 - 550 °C.

Step one utilized 6 filter clusters each containing 150 sq. ft. of surface area in "triads" of 2 3/8" tubes. These units now are composed of Inconel Alloy which has proven to be superior in life to the stainless steel used in earlier production units. These units have been in operation since 1976.

Step two utilizes 8 filter clusters of similar size and construction. The application in the oxidizing step is less difficult in terms of corrosion and blinding of the filter media.

The newly marketed jet-pulse cleaning technique was not available at the time of installation of the filter units and would require major retrofitting to adapt from the existing blow-rack cleaning arrangement.

Control of the cleaning cycle is determined by pressure drop across the set of filters with 5 to 8 lbs/sq. in. being the normal working pressure drop. Blow-back is 90 lbs/sq. in. with air provided by a screw conveyor and preheated prior to application. An air receiver is necessary to maintain pressures. Approximately 3 filter volumes of air is required for each blow-back. A blow-back cycle takes about 8 seconds and consists of (1) isolation valve closure (2) blow-back valve open (3) air release (4) air cut off (5) valve closure and (6) isolation valve open.

The filter tube clusters have required periodic cleaning by professionals (Southern Metal Co.). In the first stage reactor some growth of polymers takes place in the filter bed and ultimately blinds the apertures. Life between cleanings is 6 months for these units. Transportation of the units requires extreme care to avoid

damage to the elements. Pretesting is done prior to reinstallation by operators (as well as by Southern Metal).

The second (oxidizing) application is much cleaner and life between cleanings is 4 to 5 years (confirmed by reviewing their record book).

Some abrasion/stretching of the pores occurs over the filter life and as a consequence, performance after cleaning is better than when new.

Cleaning (including transport) typically takes 2 months. Fermenta maintains a complete set of spare tube clusters in inventory to ensure that they are never shut down by filter failures. They also keep a couple of sets of triads in inventory so that they can cut a defective set out and weld a new triad in. It is often possible to simply cut a triad out and plug weld the intake if the filters are not near the end of their life cycle.

Jim Amedeo has been at the plant for 8 years and has experienced every eventuality, in his own view. The present set up is not a concern and servicing is generally done while they are down for other maintenance.

The Fermenta plant has a 5-ton crane dedicated to each furnace complex including the filters. After removal of a tube cluster they place the assembly in a container (totally enclosed) and blow off the toxic catalyst with air. They then wrap it in a poly bag and store until they have a number of units "racked." Prior to shipment they further clean the assemblies with high pressure 1200 to 1300 p.s.i. water jets.

The plant has a "hot room" where they heat clean assemblies from Southern Metals for 24 hours at 120 °C to ensure they are bone dry before installation. Any residual moisture causes caking and baking on the filter and seriously impairs the useful life.

According to Ben, the filter porosity at this plant is 55 microns in liquid application but is considered 1 microns absolute retention in gas application. Jim said he believes their filters are "nominally 3 microns" size. The only loss apparently is from abrasion of less than 1 microns particulates.

They have two other Pall filter applications at the plant - not high temp. One is liquid and one is a dust removal application.

Ken Blower

cc: K. Morton  
N. Figgess



# Porous metal filters prevent fluid bed catalyst loss

Expensive vanadium catalyst retained in fluid bed; no other particulate collection required

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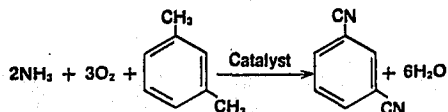
Greens Bayou Plant

Houston, Texas

MARX ISAACS, Houston Regional Editor

Porous metal filters are the only devices required to provide high retention of catalyst solids in two high temperature fluidized beds at Diamond Shamrock's Greens Bayou site. Operating at over 750°F, the reactor and re-oxidizer fluid beds contain a vanadium catalyst that is too costly to lose by elutriation. The porous metal filters not only retain the catalyst within the fluid beds, but, since optimization of the filter metallurgy, do so with a minimum of downtime for cleaning and maintenance.

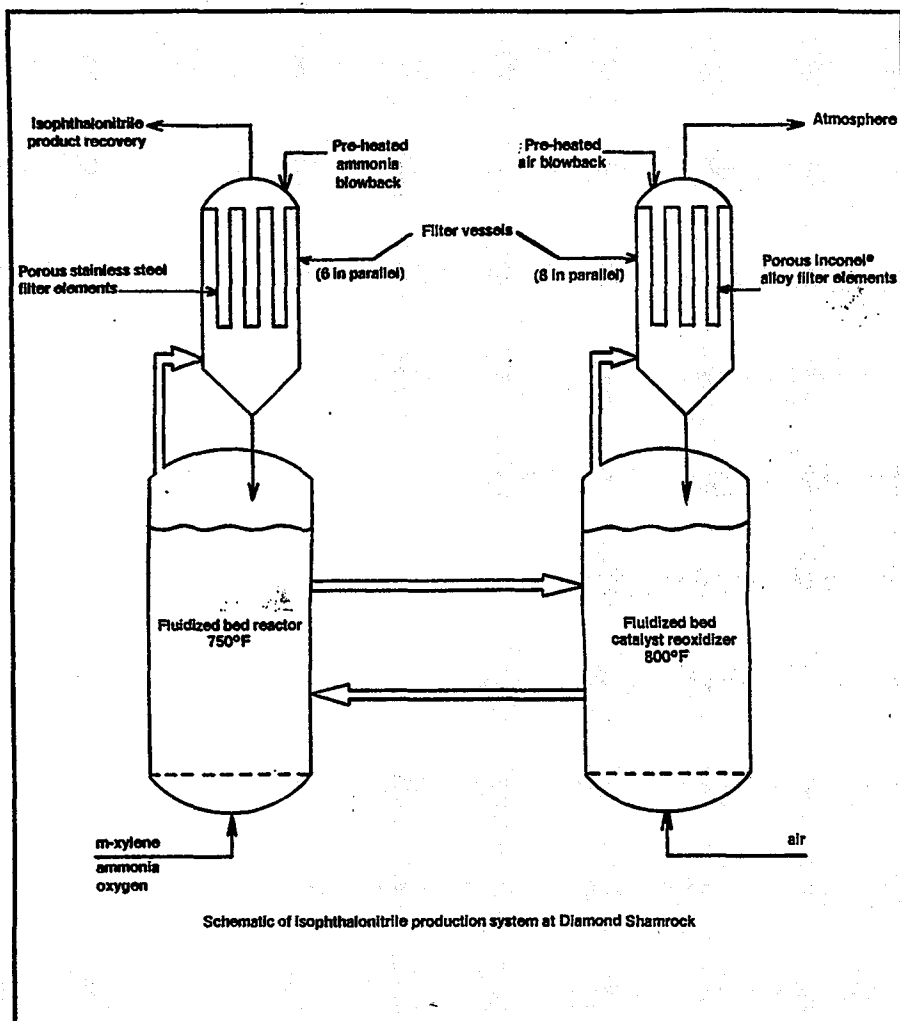
In 1976, Diamond Shamrock began operation of a unit to produce isophthalonitrile, an intermediate in the production of herbicides and fungicides. Using the basic chemical reaction



Diamond Shamrock chose a proprietary aromatic nitrile process technology that had not previously been applied commercially. The process uses a vanadium catalyst in a fluid bed reactor operating at 750°F, with catalyst being continuously reoxidized in an adjacent re-oxidizer fluid bed.

Minimizing loss of the expensive vanadium catalyst was essential to the economic viability of the project. Catalyst loss could also cause other difficulties. Elutriation from the reactor could enter the downstream product recovery system, causing operating problems, and losses from the re-oxidizer could be emitted to the atmosphere, causing environmental problems.

Conventional cyclones normally used to retain solids in high temperature fluid-



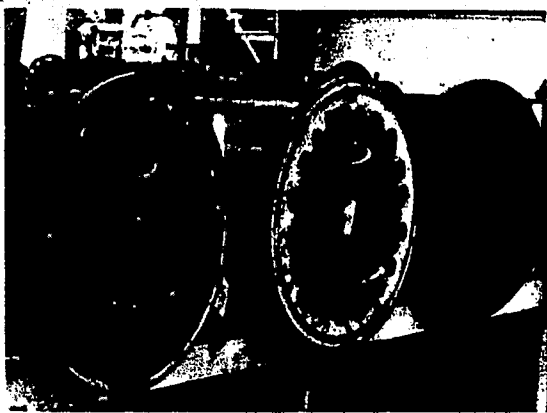
Schematic of Isophthalonitrile production system at Diamond Shamrock

Filter modules removed for inspection and cleaning

ized beds were not considered efficient enough for this process. Therefore, Diamond Shamrock installed a porous metal blowback filter system on the exit gas stream from each fluid bed to provide positive particle retention.

The overall system (see flow chart) provides parallel banks of filter vessels on each fluid bed to allow sequential blow-back of each vessel. To accommodate the different flow conditions in the two fluid beds, the reactor was equipped with 6 vessels while the re-oxidizer was equipped with 8.

Initially, each vessel was equipped with 57 1/4" diam filter elements fabricated from sintered stainless steel powder to provide removal of particles 3 microns and larger. Since this was the first operating system of any size for this process, the startup was not uneventful. Operating conditions of the re-oxidizer were slightly different than anticipated. The stainless tubes experienced embrittlement, cracking, and buildup of catalyst between tubes. Thus, a change in the filter element configuration and metallurgy for the eight reoxidizer filters was



*Heavy insulation covers porous metal filters on top of high temperature fluidized bed*

required. Each vessel on the re-oxidizer still provides about 150 sq ft of filter area, but now contains 2 3/8" diam elements constructed of a sintered Inconel® high nickel alloy. Designed to retain particles

greater than 1 micron, the filter tubes have successfully withstood the service requirement.

Filter vessels are blown back sequentially on a timed cycle, using approximately two vessel volumes of gas for each 5-7 sec blow-back. Every 15 seconds a filter is blown back. This periodic fluctuation of gas flow through the system does not cause any noticeable disruption of the fluidization or elutriation characteristics of the units.

Since modification of the re-oxidizer filter vessels, maintenance on the filter has been minimal. High retention of costly vanadium catalyst within the beds and infrequent cleanout required of the filters have resulted in an economically sound entrainment separator system. Discharge of catalyst to the atmosphere is within acceptable limits and catalyst loss to the product stream is so low that only a

minor amount is collected in the recovery system feed tank—too little to justify recovery—and discarded by an infrequent purge. ■

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*PSS® porous metal filter supplied by Pall Process Filtration Corporation, Cortland, NY 13045.*

*Inconel® alloy is a product of Huntington Alloys, Inc., Huntington, WV 25720.*

*Aromatic nitrile process technology, engineering design and construction provided by C-E Lummus Co., Division of Combustion Engineering Inc., 1515 Broad St., Bloomfield, NJ 07003.*

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