

INSTRUCTIONS FOR VACUUM SCREENING OF MECS[®] CATALYST FOR SULFURIC ACID

GENERAL

Screening the converter catalyst will be necessary from time to time due to increased pressure drop from dust and scale. In spent acid regeneration and metallurgical plants, impurities not removed in the gas cleaning system will deposit on the catalyst. In sulfur burning plants, impurities from the sulfur will accumulate in the catalyst and cause pluggage. The increased pressure drop limits plant capacity and increases the cost of production.

Today, most rock and catalyst are removed from the converter by vacuum. The catalyst is collected in a cyclone separator and fed onto a mechanical screen, which separates the quartz rock or ceramic balls from the catalyst and the catalyst from the fines in one operation. In some instances, it is desirable to separate pellet catalyst from ring catalyst so that the ring catalyst can later be reinstalled on top to maximize dust penetration. This minimizes the pressure drop buildup rate. Table 1 gives a choice of screen sizes to achieve good separation of support media and MECS[®] Catalysts while keeping screening losses at reasonable levels and retaining acceptable size catalyst for reuse.

Normally, catalyst screening is contracted to companies who specialize in this work. The contractor can supply the vacuum unit with hoses, screens, etc., and a crew of workers to operate this unit to suit the plant requirements, including turnkey contracts. However, the plant owner often supplies his own crew of workers with a labor supervisor to handle the catalyst removal and storage in containers for later refilling of the converter.

Catalyst movement inside product packages during transport will create fine dust. Keep unnecessary personnel away from the work area when emptying catalyst packages or when working with the catalyst. If enclosed handling cannot be guaranteed, ventilation, protective clothing, and other personal protective equipment must be used.

Avoid catalyst contact with skin and eyes. Skin irritation occurs on contact with wet or moist skin. Avoid inhalation of dust. Catalyst dust is toxic due to its vanadium salt content. Crystalline silica (quartz and cristobalite) may be present in both new and used catalyst. Respirable crystalline silica (that can lodge deep in the lungs) is classified as a known or probable human carcinogen by various international authorities.

Observe good personal hygiene measures after handling this material such as removing contaminated clothing and PPE and washing before eating, drinking and/or smoking.

SUGGESTED PROCEDURE FOR VACUUM SCREENING OF MECS[®] CATALYST

1. If permanent platforms do not exist at the converter manhole(s) prior to shutting down, erect temporary platforms at the converter manholes(s) from which catalyst will be removed. Provide safe access to the platform(s).
2. The screening operation should not be conducted while it is raining because the rain or high humidity may damage the catalyst. Catalyst that is exposed to high moisture may have reduced structural integrity and a loss of conversion performance. Polyethylene sheeting and rope or wire should be on hand to cover the manholes during rainfall and whenever screening work is not taking place.
3. Cool the converter by blowing dried air through it until the temperature is low enough for people to work safely. Once the dry blow is complete and the converter is opened up, it will cool rapidly to the point where it can be worked in comfortably. General safety for confined space entry should be followed, such as checking the atmospheric conditions before entering the space.
4. The bed thermocouples and wells should be removed before removing the catalyst so that they will not be damaged.

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5. Prior to removing catalyst and support media (quartz rock or ceramic balls), draw a line around the converter shell at the rock level. When the converter bed is empty, draw another line 2 inches (50 mm) below the original one. These will serve as guides for reloading to the proper height. If used sparingly, a can of spray paint can simplify marking the levels.
6. The screened support media and catalyst should be collected in dry, closed waterproof bags or drums and stored on pallets until ready to return to the converter. Catalyst should be stored indoors (recommended) or covered and protected from weather outdoors. The drums or bags should be clearly labeled with the catalyst pass number and the catalyst location in the bed (top, middle, or bottom).
7. The vacuum hose should be smooth, soft rubber on the inside, and the collecting vessel (cyclone separator) should be lined with a soft, smooth material to minimize catalyst breakage on impact.
8. Preferred vacuum hose diameter is 6 inches (15 cm) to minimize catalyst breakage. Absolute minimum diameter of the hose should be 4 inches (10 cm). The key factor in sizing the hose diameter is the linear velocity of the catalyst. Air velocity should not exceed 150 ft/second (45 m/s). This can be determined from the air blower capacity curve at various RPM.

A transition section of 6 inch (15 cm) or 8 inch (20 cm) hose should be installed before the inlet to the cyclone. (This transition section reduces the inlet velocity to the cyclone.) The total length of vacuum hose should be minimized, and sharp bends must be avoided.

9. The minimum diameter of the separation cyclone itself should be 36 inches (90 cm), with a 6 inch (15 cm) or 8 inch (20 cm) inlet nozzle. (The larger the diameter of cyclone, the smaller the angle of impact between the catalyst and the inside wall.)
10. The hose from the converter manway, down to the cyclone, should be slightly angled from the vertical to avoid catalyst free-fall. Dips or low spots should be avoided.
11. Either a flapper valve arrangement or a modified rotary air lock should be used to isolate the cyclone from the screen. A standard start valve, where the vanes turn while the wall is immobile, is not recommended. A standard start valve can crush the catalyst between the side walls and the edges of the vanes. The holding chambers in the flapper valve design and the rotary air lock design should have capacities twice the conveying rate of the system, so that they do not overflow and cause excess rough handling of the catalyst.
12. Vacuuming begins by removing the top support media, starting near the side wall opposite to the access manway and finishing at the access manway. After the support media has been removed, the catalyst should be vacuumed up, starting at the access manway. **The recommended screening rate is approximately 3000-4000 liters/hour.** It is recommended to vacuum the catalyst in layers (top, middle, and bottom). Move the end of the hose continuously and press it into the catalyst face to keep the hose as full as possible without plugging. This minimizes ring catalyst breakage. After all the catalyst has been removed, vacuum up the bottom rock to expose the support grids for inspection and/or further cleaning.

Ring catalyst that is vacuumed with support media has high breakage. When vacuuming the top layer of support media, the vacuum hose should be kept parallel to the surface to minimize carryover of catalyst at the same time. The hose should also be kept horizontal when vacuuming the catalyst just above the bottom layer of support media for this same reason.

13. Observe the condition of the grid slots and clean out if they are plugged with bits of rock and catalyst. Normally, these grid slots will not require cleaning, but occasionally small pieces of rock become lodged in these slots causing added pressure drop.

In carbon steel converters, it is recommended to inspect the caulking between the grids and the shell and the spacing between grids to check that there are no openings large enough to allow rock and catalyst to fall through the grids. Some division plates are covered with insulating brick. This insulation brick should be inspected and repaired, if necessary.

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14. When reinstalling catalyst, be sure a level, 2 inch (50 mm) layer of quartz rock or ceramic balls is installed on the grids first. Use wide boards or panels of plywood as a walking platform inside the converter. In no case should workers be permitted to walk directly on the support media or catalyst, as this will create an uneven layer of support media and will break the catalyst.
15. Install the bottom thermocouple(s) on top of the bottom layer of quartz rock or ceramic balls. Thermocouples should always be located at the rock/catalyst interface. Approximately 6 inches (150 mm) of the tip end of the thermocouple should not be in direct contact with the catalyst, but should rest on a single layer of rock with another layer of rock above it.
16. Screened, original catalyst should be installed in the lower portion of the bed first, layer by layer. The screened catalyst from the bottom layer of the bed will be placed at the bottom of the bed again. The middle screened layer is added next, and then the top screened layer is replaced. New, fresh catalyst is then installed on top of the older catalyst. This approach should be used for all passes of converter. After the specified amount of catalyst has been placed in a converter pass, the layer should be carefully leveled to ensure uniform thickness in the catalyst bed.
17. Install the top thermocouples(s) on top of the catalyst. Thermocouples should always be located at the rock/catalyst interface. Approximately 6 inches (150 mm) of the tip end of the thermocouple should not be in direct contact with the catalyst, but should rest on a single layer of rock with another layer of rock above it.
18. A minimum 2-inch (50 mm) deep layer of quartz pebbles or ceramic balls is placed on top of the catalyst in each converter pass. This top hold down layer should be carefully leveled also.
19. Before closing the manway covers, inspect to determine that all equipment has been removed, all catalyst beds are level, and all parts of the converter are clean. Remove any dust that may have fallen through the grids onto the division plates while installing the catalyst. The use of a vacuum cleaner is desirable, but brushing with a soft brush does a satisfactory job. Any dust or dirt left on the division plate may blow into the next layer of catalyst.
20. The manways should be closed and the converter sealed off from all access by water or wet air until the plant is restarted.

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Table 1: Recommended Screen Sizes for MECS[®] Catalysts

To Separate Support Media from Catalysts, Use:

Screen Sizes	Comments
5/8" x 5/8" (15.7 mm x 15.7 mm) Square	Retains Support Media
9/16" x 1.0" (14 mm x 25 mm) Slotted	Retains Support Media
9/16" x 1-1/2" (14 mm x 38 mm) Slotted	Retains Support Media

To Separate GR-330, GR-310, XLP-110, XLP-220, XCs-120, SCX-2000, LP-120, and Cs-120 from Other Rings, Pellets or Fines, Use:

Screen Sizes	Comments
3/8" x 3/8" (9.4 mm x 9.4 mm) Square	Retains Essentially Whole Rings
3/8" x 2" (9.4 mm x 50 mm) Slotted	Retains Essentially Whole Rings

To Separate GR-330, GR-310, XLP-110, XLP-220, XCs-120, SCX-2000, LP-110, LP-120, LP-220, Cs-110, and Cs-120 from Pellets or Fines, Use:

Screen Sizes	Comments
9/32" x 2" (7 mm x 50 mm) Slotted	Retains Whole Rings
5/32" x 2" (3.9 mm x 50 mm) Slotted	Retains Whole Rings, Plus Acceptable Chips
1/4" x 2" (6.3 mm x 50 mm) Slotted	Retains Whole Rings, Plus Acceptable Chips
7/32" x 2" (5.5 mm x 50 mm) Slotted	Retains Whole Rings, Plus Acceptable Chips
3/16" x 2" (4.7 mm x 50 mm) Slotted	Retains Whole Rings, Plus Acceptable Chips

To Separate T-11, T-210, and Cs-210 Pellets from Fines, Use:

Screen Sizes	Comments
1/8" x 2" (3.1 mm x 50 mm) Slotted	Retains Minimum Acceptable Size Pellets

NOTE: Screening losses are normally made up by adding fresh, whole ring catalyst on top of the screened material. Chipped ring catalyst, mixed with whole ring catalyst, can be reinstalled in all converter beds, with no measurable increase in "clean" plant pressure drop. The rate of subsequent pressure drop increase is proportional to the size and quantity of the broken pieces. This can be controlled by occasional screening with a larger screen size opening.