

## TECHNICAL BULLETIN:

# Start-up and Shutdown Procedures for CRITERION\* Hydrotreating Catalyst

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Proper start-up and shutdown procedures are essential to maintain optimum catalyst activity. The proper procedures for a particular hydroprocessing unit will depend upon the limitations of the physical equipment in the unit. Nonetheless, there are several general steps designed to protect the catalyst that should be incorporated in any start-up or shutdown procedure.

## **SHUTDOWN**

Shutdowns can be either planned or be necessary because of an emergency. In either case, protection of the catalyst requires procedures to avoid excessive coke formation. Coke formation will occur when oil is heated with the catalyst at reaction temperatures under a low flow rate of hydrogen. Accordingly, during a scheduled shutdown, the oil flow rate should be stopped and the catalyst stripped of the oil under maximum hydrogen recycle rates. During stripping, the reactor should be cooled with maximum hydrogen circulation to 205°C (400°F) if a short turnaround is desired or to 65°C (150°F) if a longer turnaround is expected. In the latter case, the unit should be depressured, purged of hydrogen with nitrogen, and blocked in under nitrogen.

In an unscheduled shutdown, the preceding procedure should be followed if possible. If it is not possible to strip the oil from the catalyst due to a total loss of hydrogen circulation, the unit should be depressured slowly in accordance with equipment limitations and the reactors cooled by introducing nitrogen when the pressure is low enough. If hydrogen is available at low pressure, it is the preferred purge medium to use to sweep oil from the catalyst and cool the catalyst bed. When the reactor has been cooled to 65°C, (150°F), it should be blocked in the reactor under nitrogen pressure.

## **START-UP**

This procedure pertains to start-up after a shutdown rather than the initial start-up with fresh catalyst which incorporates pre-sulfiding. During restart after shutdown, the primary concern is to make sure that the catalyst remains fully sulfided and to strip off coke of recent deposition. If the shutdown has been short (less than a shift) and the catalyst was blocked in under hydrogen at a temperature of at least 205°C, (400°F) no special precautions should be required. If, however, the shutdown has been so long that it has been necessary to cool and depressure the reactor, the subsequent start-up should be much more gradual.

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After starting hydrogen circulation, the reactor should be heated at a maximum of 27°C (50°F) per hour to 370°C (700°F) with at least 1,000 ppmv H<sub>2</sub>S in the recycle hydrogen. The temperature is held for at least 8 hours and the reactor is cooled to 180°C (350°F) and the feed is cut in at 50-70% of normal rate. The temperature should then be increased to 250°C (475°F) at a rate of 27°C (50°F) per hour and held until sulphur breakthrough has occurred (sulphur concentration of more than 1,000 ppmv in the recycle gas). The feed rate should then be increased to 100% and the temperature increased to normal operating temperatures at a rate of 27°C (50°F) per hour.

NOTES: (1) The above procedure should be performed with a straight run stock. Once sulphur breakthrough has occurred, increase feed rate to 100% and lower the reactor temperature to 205°C (400°F). Gradually switch to normal feed over several hours and line out at 205°C (400°F) prior to increasing reactor inlet temperature. (2) Always maintain a minimum of 1000 ppmv H<sub>2</sub>S in the recycle hydrogen when the catalyst temperature is > 250°C (475°F).

## **GENERAL**

Although the recommendations provided above are general in nature, at your request, assistance in developing start-up and shutdown procedures tailored to the use of CRITERION Catalysts in your hydroprocessing unit will be supplied as part of your catalyst purchase.

## **HEALTH, SAFETY, AND ENVIRONMENTAL PRECAUTIONS**

CRITERION hydrotreating catalysts are made from chemicals which span a range from being almost non-toxic to being potential carcinogens. Full attention to these hazards and to appropriate precautions and preventative measures is essential. Before ordering, testing, loading, or using these catalysts, be sure to obtain available information on health, safety, and environmental hazards, precautions and preventative measures from your CRITERION Catalysts Representative.

## **ADDITIONAL INFORMATION**

All catalyst information supplied by CRITERION is considered accurate but is furnished with the express understanding that the customer receiving such information shall make its own assessments to determine suitability of such information for customer's particular purpose. All purchases of catalyst from CRITERION are subject to CRITERION's standard terms and conditions of sale (including CRITERION's product warranties) set forth in a sales proposal, sales contract, order acknowledgement, and/or bill of lading.

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