CRITERION
CATALYSTS & TECHNOLOGIES

TECHNICAL BULLETIN:

Loading Your Hydrotreating Reactor for Maximum Activity

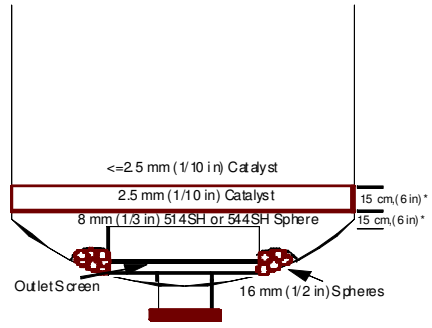
If your hydrotreating unit is activity limited, ie. run length is limited by thermal constraints, careful attention to maximum utilization of the reactor volume can increase your unit's run length. Dense loading methods are the most popular for increasing the total weight of catalyst for a given volume which can improve the reactor's activity by 3-6°C (5-10°F). The benefits of dense loading have been well documented and will not be the focus of this article. However, several refiners miss out on significant reactor volume by not concentrating on minimisation or complete replacement of inert material in the reactor and minimisation of free board space in the reactor.

From the Bottom Up

When planning the reactor load, always start from the bottom of reactor. Carefully examine your outlet configuration. Ask the question: Is there any free space that can be filled with "active support" like CRITERION 514SH or 544SH or catalyst? Carefully examine the outlet screen slot space before beginning to plan the support load. Consult the design drawings and also check the inspection history looking specifically for the actual condition of the wire. A damaged outlet screen will have much larger slot spaces than the design. Any support material that is used should be 2.5 times larger than the slot space. This will prevent broken pieces of support from being able to pass through the outlet screen.

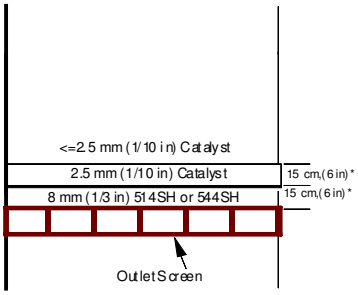
Figures 1 and 2 show typical configurations of reactor outlets where inerts have been minimised.

Figure 1



* For Reactor ID's less 8 ft, 8cm(4 in.) can be used

Figure 2



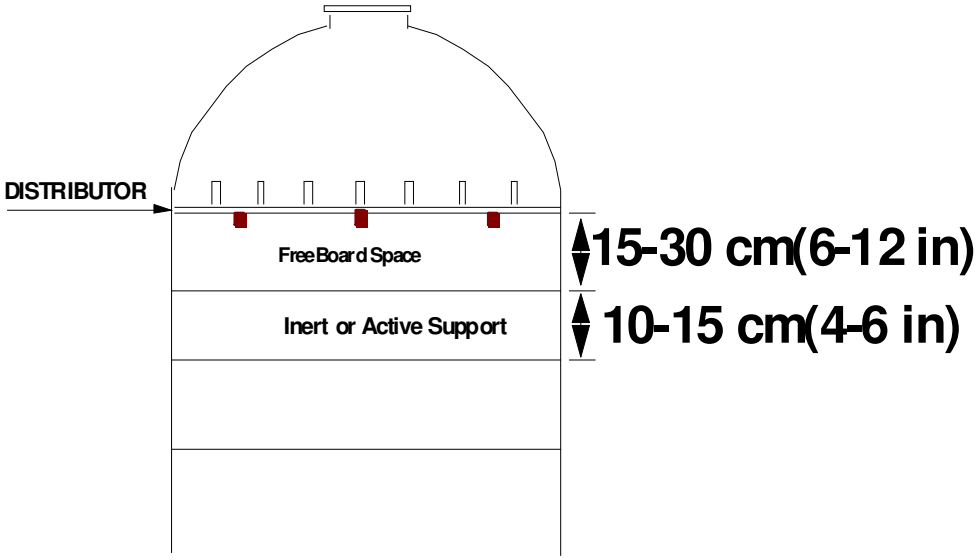
In Figure 1, a layer of 13 mm (1/2 inch) inert support has been placed around the bottom edge of the outlet screen to prevent bypassing underneath the bottom edge. The bottom head of reactors are not always perfectly smooth so there frequently exists some large openings between the bottom edge of the outlet screen and the reactor bottom head. ½ inert material should provide enough buffer for these openings. For most reactors, 2-5 ft^3 should be enough inert material to accomplish this. 8.0 mm (1/3 in) Criterion 514SH or 544SH active support is sock loaded to cover the outlet screen 6 inches above the top of the screen. The active support should be carefully leveled prior to beginning the next level within +-1 inch. At this point, 2.5 mm (1/10 in) catalyst can be loaded directly onto the active support. CRITERION recommends ratios of less than or equal to 3.5 when changing catalyst sizes of the outlet support or catalyst to prevent catalyst migration. If 1.6 mm (1/16 in) or 1.3 mm (1/20 in) catalyst is to be used in the reactor load, a minimum of 6 inches (4 inches if the reactor ID is less than 8 ft) of 2.5 mm (1/10 in) catalyst should be loaded.

In Figure 2, 8 mm (1/3 in.) CRITERION 514SH or 544SH is loaded directly onto the outlet support screen. It is important to remember that this should only be done if the slot space of the screen is less than 2.5 times the size of the active support used. Otherwise, a 10-15 cm(4 to 6 inch) layer of 13 mm (1/2 in) or larger inert should initially be used. If dump tubes are present, fill these with inert material. It is important to ensure that all gaps between outlet screen pieces and around thermowells are sealed with ceramic fibre or by mechanical means.

Topping Off the Reactor

As the level of the bed approaches within 3 feet of a dense loader (if being used), the dense loading device should be removed and the remaining catalyst should be sock loaded. Whether high void inert (855MD), high void catalyst (824HC or 814HC), spherical inert, or active support (514SH or 544SH) are being used to complete the reactor load, the top level of the bed should be within 15-30 cm (6-12 in) of the distributor. Do not load material all the way to the level of the distributor as this can disturb the even distribution pattern. This guideline should provide enough distance for the distributor to evenly distribute the two phase mixture. If the distribution tray is not completely removed when catalyst loading occurs, a long board (2x4) can be used to evenly spread the top layer within 15 - 30 cm (6-12 in) of the distributor.

Figure 3



Criterion recommends that at least 6 inches (4 inches for reactor ID's less than 8 ft) of high void inert support (854RG) or active spherical support (514SH or 544SH) be placed on top of any catalyst as long as a modern flow distributor exists. Older designs should be evaluated by CRITERION before this recommendation will be made. If no flow distributor exists, CRITERION recommends the use of a high density inert sphere with a density of 80-110 lb/ft^3.

The guidelines provided here will minimise the amount of inert and optimise the amount of active support and catalyst. The end result will be a larger volume of the most active catalyst and a significant increase in the runlife of your reactor.

CRITERION technical service engineers are available to help in the optimisation of catalytic activity of your hydrotreating reactors.

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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