

TK-558 BRIM™

FCC pretreater unit (F: Russia)

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**Metal tolerance**

In May 2008 a refinery in Russia installed a full charge of TK-558 BRIM™ catalyst in their large low-pressure FCC pretreater unit. TK-558 BRIM™ is a cobalt molybdenum based hydrotreating catalyst designed to give high sulphur removal (HDS) in demanding VGO services.

The refinery is processing some very tough crudes of Ural and Arlan (Bashkir) origin, and the severity of the crudes makes the operation of the vacuum distillation challenging in terms of fractionation. This means that there is a bad separation of VGO and vacuum tower bottom, and this results in a resid contaminated VGO to be processed in the FCCU. The severity of the combined FCC pretreater feed calls for an extremely robust catalyst system to deal with the level of heavy metals. The content of Ni+V is 15-20 wt ppm, which is extraordinary high for this type of process, and it implies a rapid poisoning of the working catalyst, even though a protective HDM guard catalyst is also loaded.

The FCC pretreater is of Russian design and was during the cycle revamped into a 4-reactor unit, whereby the catalyst volume was doubled. This revamp takes place around run day 400 in the cycle. Hereafter, the deactivation slowed down due to the new low LHSV.

The fact that the unit has been operated at a quite low temperature while processing the contaminated feed makes the

run a very interesting study in the effect of metal poisoning on the HDS activity. The deactivation observed during the cycle is exclusively related to metals plugging the pores in the catalyst structure and not to coking of active sites.

A conventional HDS catalyst with a traditional pore system would not be able to maintain its HDS function while being subjected to such level of contaminants, but one of the unique features of the BRIM™ Technology catalysts is their robust pore structure, giving a very high poison tolerance. Figure 1 illustrates the steady and predictable deactivation of TK-558 BRIM™ during the initial period of operation. The average deactivation is 4°C/month. This is obviously a fast rate, but it is low when realising what type of feed is being processed. From sample analysis of spent TK-558 BRIM™ from other units it has been demonstrated that the catalyst is able to withstand a contamination level of more than 8-10 wt % Ni+V while still providing activity for removing sulphur and nitrogen.

Such high metal tolerance is one of the key parameters, making TK-558 BRIM™ and its successors TK-560 BRIM™, TK-561 BRIM™ and TK-562 BRIM™ the most stable and robust catalysts in the current market. Most clients using these catalysts experience the lowest deactivation rates in their plants.

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The feed has the following properties:

Table 1	
Crude origin	Ural and Arlan (Bashkir)
Feed type	SRVGO + HVGO + VBGO
Density, kg/m ³	950
Sulphur content, wt%	2.4
Nickel + Vanadium, wt ppm	4 + 14
Distillation (D-1160), °C	
10%	330
90%	530
FBP	690

The unit is operated at the following conditions:

Table 2	
LHSV, hr ⁻¹	0.5 – 1.3
Hydrogen pressure, bar	47
Hydrogen to oil ratio, Nm ³ /m ³	500

Figure 1. Normalised HDS temperature for TK-558 BRIM™

