

## Comparison of Plate Type Catalyst With Honeycomb and Corrugated Catalyst For Ash-Pluggage Potential

Hitachi plate type catalyst has a higher resistance to ash pluggage because of its unique shape compared with honeycomb and corrugated type catalyst. There are both theoretical reasons and an empirical result for this, which are described below.

***Hitachi Plate Type Catalyst has larger hydraulic diameter compared with Honeycomb and Corrugated Type Catalyst.***

Figure 1 shows the geometry of plate, honeycomb and corrugated type catalyst in the same scale. Plate type catalyst has rectangular openings which the flue gas and ash pass through. Honeycomb type catalyst, on the other hand, has square openings and corrugated type catalyst is similar in size to honeycomb but has rounded corners. Table 1 shows the hydraulic diameter of plate, honeycomb and corrugated type catalyst for a typical coal-fired application. The larger hydraulic diameter the catalyst opening has, the easier it is for the ash in the flue gas to pass through the catalyst openings. The hydraulic diameter of honeycomb type catalyst with 6.9mm pitch is 33% smaller than that of plate type catalyst with 5.7mm pitch. Even 9mm pitch honeycomb type catalyst is 14% smaller hydraulic diameters than plate type catalyst. That is the one of the reasons why plate type catalyst has much lower possibility to plug with ash as compared to honeycomb and corrugated type catalyst.

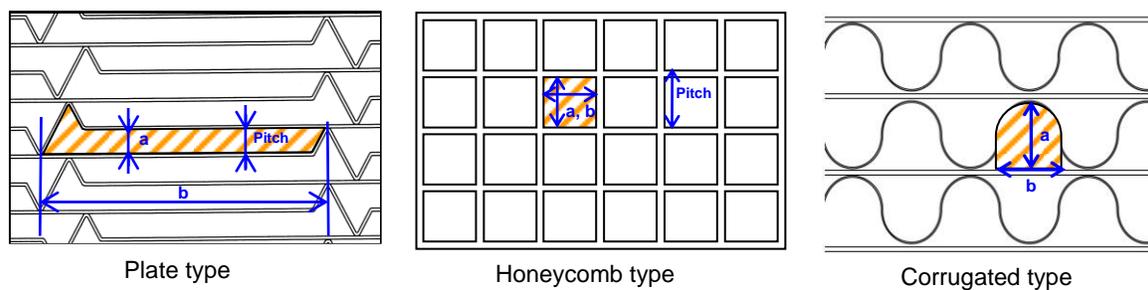


Figure 1: Geometry of Plate (5.7mmP), Honeycomb (6.9mmP) and Corrugated (6.5mmP) Type Catalyst (in the same scale)

	Plate	Honeycomb	Corrugated
Nominal Pitch, mm	5.7 (7)	6.9 (9.0)	6.5 (9.0)
a, mm	5 (6.3)	6.2 (8.0)	6.5 (9.0)
b, mm	62 (85)	6.2 (8.0)	6.5 (9.0)
D <sub>h</sub> , mm	9.25 (11.7)	6.2 (8.0)	5.06 (7.0)
Difference vs. Plate	--	-33% (-14%)	-45% (-24%)

$$D_h = 4 \times \text{Cross Sectional Area (mm}^2\text{)} / \text{Perimeter (mm)}$$

Table 1: Comparison of Plate, Honeycomb and Corrugated Catalyst Hydraulic Diameter

*Hitachi Plate Type Catalyst has smaller low gas velocity area compared with Honeycomb Type Catalyst.*

The accumulation of ash in catalyst usually begins to grow up at the corner and in the lower velocity area as a starting point. The gas velocity in the catalyst opening has distribution as shown in Figure 2. This figure shows that plate type catalyst has smaller low gas velocity area in the gas velocity distribution than honeycomb type catalyst. And as shown in Figure 1, plate type catalyst has fewer corners than honeycomb-type catalyst.

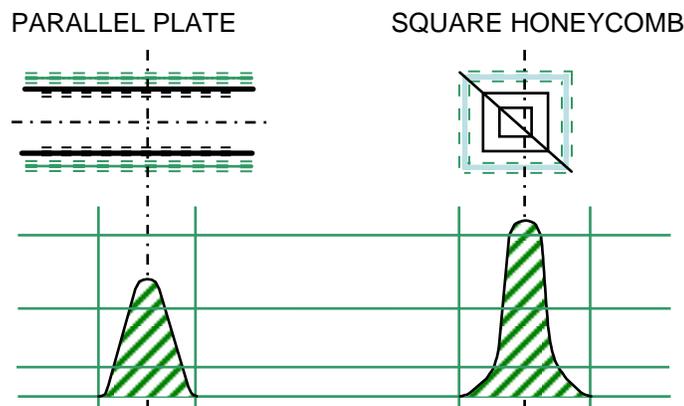


Figure 2: Gas Velocity Distributions

***Empirical Result Which Shows Hitachi Plate Type Catalyst Has Higher Resistance To Ash Pluggage compared with Honeycomb-Type Catalyst.***

E-on/Heyden 4 power station in Germany has a unique catalyst configuration with Hitachi plate type catalyst (6mm pitch) installed in the 1<sup>st</sup>, 2<sup>nd</sup> and 4<sup>th</sup> layers and other catalyst supplier's honeycomb-type catalyst installed in the 3<sup>rd</sup> layer (see Figure 3). Within the third layer, the Owner mixed 8.2mm pitch and 7.1mm pitch designs as shown in Figure 6. After some operation hours, pluggage was hardly observed in plate type catalyst in 1<sup>st</sup> layer although minimum amount of LPAs (large particle ash) were observed as shown in Figure 4. As far as honeycomb-type catalyst in 3<sup>rd</sup> layer, the catalyst blocks closest to the boiler were completely plugged (see photos in Figure 5). This resulted in approximately 40% of the total catalyst layer being completely plugged, as shown in Figure 6.

This clearly shows that in the same reactor, ash was able to pass through the two layers of plate catalyst yet still cause severe pluggage in the honeycomb catalyst.

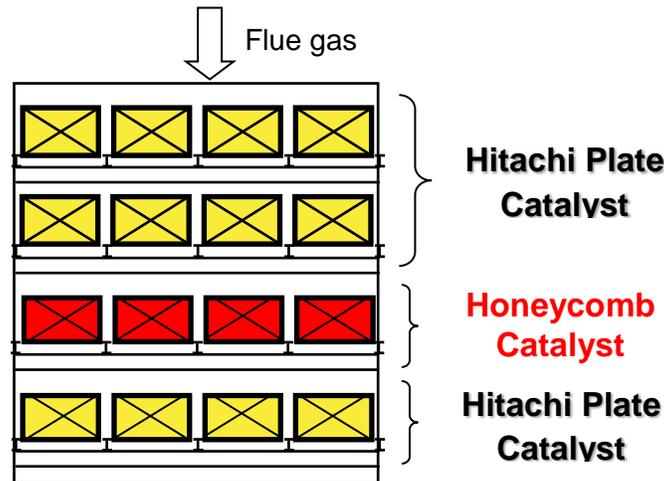


Figure 3: Catalyst Configuration for E-on/Heyden 4 Power Station in Germany



6mm pitch  
No pluggage  
(Minimum amount of LPAs)

Figure 4: Plate Type Catalyst in 1<sup>st</sup> Layer After Operation

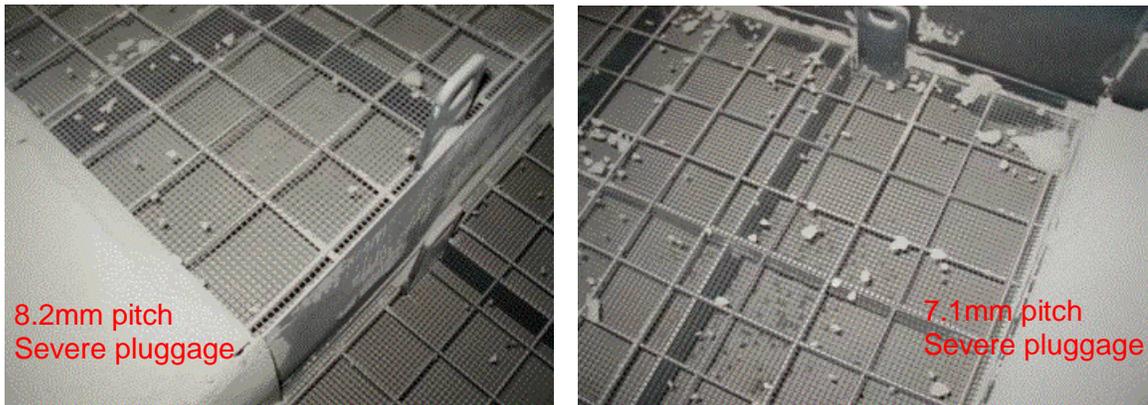


Figure 5: Honeycomb Type Catalyst in 3<sup>rd</sup> Layer After Operation

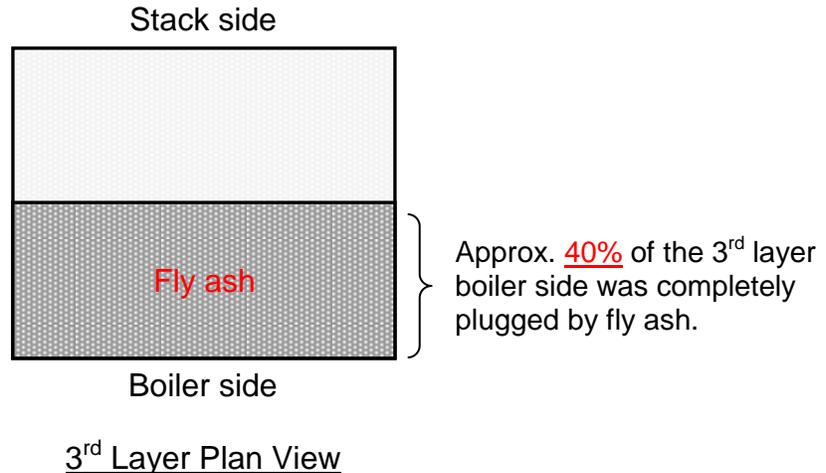


Figure 6: 3<sup>rd</sup> Layer (Honeycomb Catalyst) Pluggage Conditions After Operation

### ***Conclusions***

It is clear from the above theoretical reasons and empirical results in Germany that Hitachi's plate type catalyst has much lower possibility to pluggage by ash than honeycomb type catalyst. Similar pluggage results have been experienced with corrugated type catalyst as well. The final evaluation can be compared to a filter analogy. Plate type catalyst is a course filter while honeycomb and corrugated are fine filters. Given the same conditions, a fine filter will plug quicker than a course filter.