

Louma Works, February 23, 1943

COMPARISON OF SOLID-BED AND MOVING-BED CATALYTIC CRACKING PROCESSES

Cracking conditions: Space velocity 0.9 vol. of oil/vol. of catalyst/hour. Length of cracking period 20 min. which corresponds to 3 catalyst changes per hour in the moving-bed process. Coke deposit 2.2% by wt. of catalyst. The coke formation is based on Zisterdorf (Vienna) oil as charge stock.

Moving-Bed Process

1. Air required for catalyst regeneration
Heat of combustion of coke deposit, Q_{coke} , 0.022 · 14,400 = 318 Btu/lb. of catalyst

Heat absorbed by catalyst, $Q_{catalyst}$, 0.25 · (1112°F. - 482°F.) = 158 Btu/lb. of catalyst

Heat to be absorbed by air, Q_{air} = Q_{coke} - $Q_{catalyst}$ = 160 Btu/lb. of catalyst

Regeneration air required $\frac{160}{0.32 \cdot (1112°F. - 752°F.)}$ = 1.43 lbs. of air/lb. of catalyst = 17.7 cu.ft.

The calculation assumes that on heating the combustion air and the catalyst to 815°F. 35% of the coke must be burnt off.

$Q_{catalyst}$ = 0.25 (815°F. - 482°F.) = 83.4 Btu/lb. of catalyst

Q_{air} = 1.43 · 0.32 (815 - 752°F.) = 28.8 Btu/lb. of catalyst
112.2

$$\frac{112.2 \cdot 100}{318} = 35\%$$

2. Heat exchanger surface required for regeneration air.
Heat quantity to be exchanged, Q_A : 0.32 · 1.43 · 720 = 329 Btu/lb. of catalyst

Surface of heat exchanger : $\frac{329}{3.07 \cdot 360}$ = 0.298 sq.ft./lb. of catalyst/hour

The surface is calculated to exchange the heat quantity in 1 hour.

Solid-Bed Process

Q_{coke} : 318 Btu/lb. of catalyst

Q_{air} = Q_{coke} = 318 Btu/lb. of catalyst

Regeneration air required:

$$\frac{318}{0.32 \cdot 108} = 9.2 \text{ lbs.} = \underline{114 \text{ cu. ft.}}$$

The average temperature difference (108°F.) was obtained planimetrically from the temperature/time diagram of the experimental unit.

$$Q_A = 9.2 \cdot 0.32 \cdot 766 = 2225 \text{ Btu/lb. of catalyst}$$

Surface of heat exchanger:

$$\frac{2225}{3.07 \cdot 108} = \underline{6.72 \text{ sq.ft./lb. catalyst hour}}$$