KAYSER TECHNOLOGY

ACE TECHNOLOGY: MEASUREMENT OF CATALYST STRIPPABILITY

SUMMARY

The ACE-Model R and R+ can precisely and automatically measure the strippability of catalysts and quantify the yield shifts associated with different strip times. This capability is important for catalyst selection and development, understanding existing commercial stripper performance, design of commercial units, and for modeling the kinetics of the stripping process.

CATALYST STRIPPABILITY

Catalyst strippability is the rate which hydrocarbons are removed from the catalyst during the stripping step of the FCC process. Factors affecting stripping kinetics include the catalyst properties and temperature. The efficiency of the stripping step directly influences commercial cracking performance.

Catalyst strippability is important because many FCC strippers operate at sub-optimal catalyst residence times. Most labs, however, do not include strippability as part of catalyst testing. Instead, yield data are collected only at catalyst strip times well in excess of the commercial range (i.e., complete stripping). This often leads to questionable catalyst selections.

THE ACE TECHNOLOGY METHOD

The ACE-Model R and R+ measure catalyst strippability with high precision and automatic operation. The technique uses a series of cracking runs, each performed at a different catalyst strip time, with catalyst-to-oil ratio and temperature held constant. The effects of stripping time on all yields are determined by this technique.

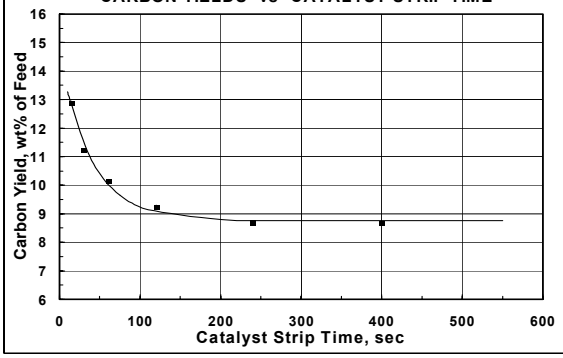
TYPICAL DATA

Tables 1 and 2 and Figures 1 through 7 summarize cracking runs at 7.50 Catalyst-to-Oil and 990°F (532°C) with a 3 Concarbon Residue (CCR) feed and a commercial equilibrium catalyst. The only variable in the runs is the stripping time which ranges from 15 to 400 seconds.

TABLE 1
CATALYST PROPERTIES

Catalyst	ECAT
Total SA, m^2/gm	213
Zeolitic SA, m^2/gm	142
Matrix SA, m^2/gm	71
Z/M	2.0
RE_2O_3, wt%	2.4
UCS	24.34
Nickel, ppmw	1400
Vanadium, ppmw	2500
Catalyst Stripping Parameters (1):	
A, wt% Strippable Carbon Mass	5.80
B, Stripping Rate in sec^{-1}	0.025
C, wt% Carbon at Infinite Strip Time	8.76
(1) Stripping Equation: Carbon, wt% = A•exp(-B•t) + C, where "t" is the catalyst stripping time.	

FIGURE 1
CARBON YIELDS -vs- CATALYST STRIP TIME



For the materials and conditions of this case study, there is about 5.8% of feed that is strippable after feed injection (Figure 1). The stripping curve in Figure 1 is used to quantitatively characterize the catalyst strippability and the results are provided in Table 1.

TABLE 2
FEED PROPERTIES

Feedstock		Heavy Feed A
API Gravity		22.3
Specific Gravity, 60/60°F		0.920
Sulfur, wt%		1.06
Total Nitrogen, ppmw		1600
Conradson Carbon Residue, wt%		3.1
Distillation (D 2887)	wt%	°F/°C
	IBP	393 / 201
	5	541 / 283
	10	616 / 324
	30	799 / 426
	50	872 / 467
	70	927 / 497
	90	1068 / 576
	95	1153 / 623
	FBP	1223 / 662

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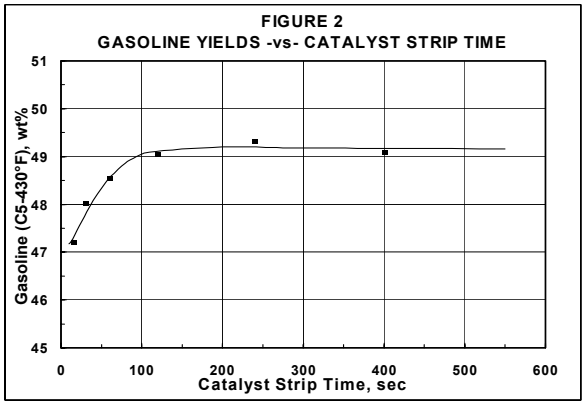
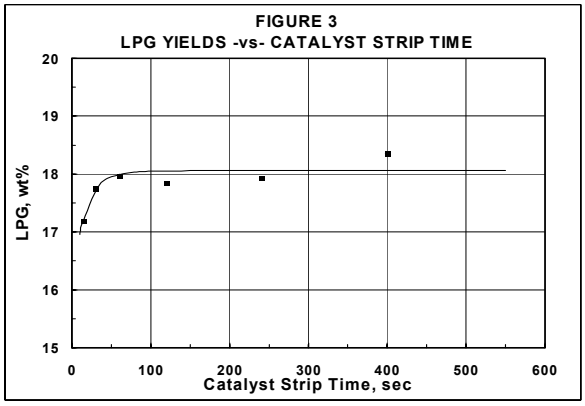
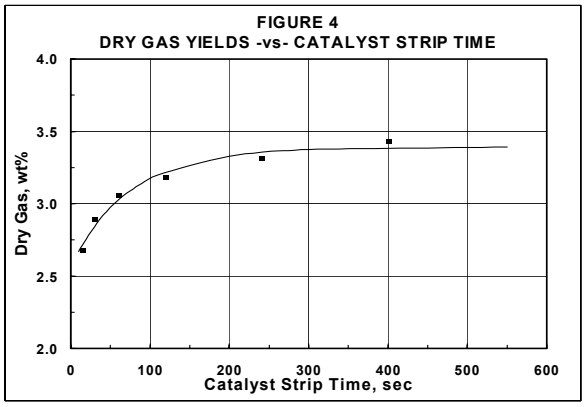
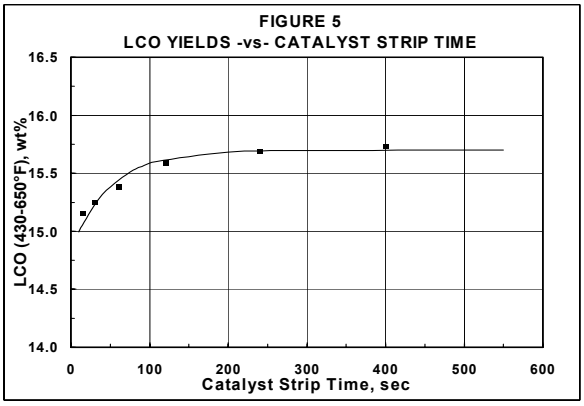




The 5.8% of feed that is strippable appears as gasoline, LPG, dry gas, and distillate (Figures 2-5). The slight increase in distillate yield with strip time means that stripping lowers conversion (Figure 6). Figure 7 shows that bottoms (650°F+ or 343°C+) species are not strippable.





Since hydrocarbons boiling below 430°F (221°C) constitute the bulk of strippable hydrocarbons, it is apparent that the predominant mechanism for removing hydrocarbons boiling above 430°F (221°C) is by cracking them to lighter species. In this regard, “strippability” is primarily a catalytic property related to the residual cracking activity of “spent” FCC catalyst.