SUPPORTING INFORMATION

Practical approaches towards NO_x emission mitigation from Fluid Catalytic Cracking (FCC) units

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Additional Catalyst Testing

In order to explore if the mixture of two well-performing catalysts would be more interesting to the refiner than either one of the components by itself, we have carried out additional experimentation and compiled the data in Figure S1 below. From Figure S1, we see that Reference-2 is superior in CO oxidation, when compared to a 50/50 mixture of Catalyst A and Reference-2. This mixture is not a calculation, but an actual sample that was measured in the same way and under the same conditions as all other samples presented in the manuscript. At the same time, Reference-2 also tends to generate more NO_x. Note that the CO/NO_x ratio for Reference-2 is 0.67 and 0.71 for the 50/50 mixture of Reference-2 with Catalyst A. While the ratio is favorable for the mixture, the absolute CO conversion values are quite different: 53.8% vs 42.1%. This would imply the prospective refiner would need to adjust dosing, which in this case would mean some 25-27% increase in promoter consumption, should the FCC unit need to reach the CO efficiency of Reference-2. In fact, if we increase the dosing to match the CO activity (Reference-2 + Catalyst A norm in Figure S1), there is minimal difference in NO_x generation, as one would expect from the CO/NO_x ratio.

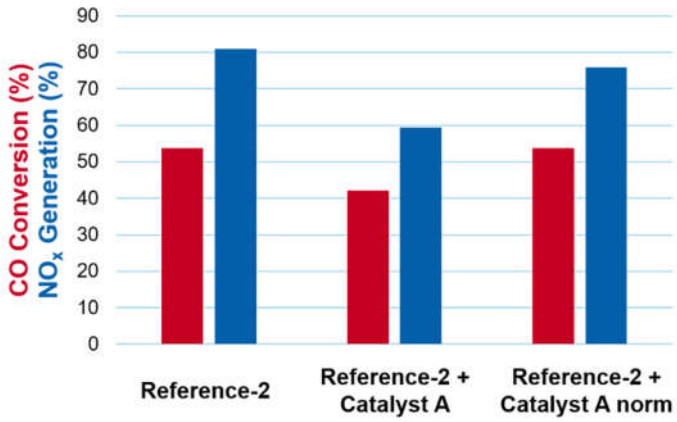

Figure S1. The CO conversion and NO_x generation emission values observed for selected catalysts are reported. The values are generated following the procedure described in Section 2.2.

Cost of performance

Table S1. The estimated PGM cost as well as measured CO conversion, NO_x generation and CO/NO_x ratio values for the samples discussed in this contribution are reported.

Promoter	PGM Cost ($/kg)[1]	CO conversion (%)	NO_x generation (%)	CO/NO_x ratio
Reference-1	230	47.0	80.6	0.58
Reference-2	450	53.7	80.9	0.67
Reference-3	910	55.7	90.2	0.62
Catalyst A	10	23.5	35.3	0.67
Catalyst B	450	46.8	65.1	0.72
Catalyst C	450	49.8	67.5	0.74
Catalyst D	10	4.8	6.8	0.71
Catalyst E	450	47.7	67.5	0.71
Catalyst F	450	47.6	79.1	0.60
Catalyst G	107	72.5	107.6	0.67

[1]The cost is reported as estimated cost based on PGM pricing at the time of publication (Q3 2021). For simplicity and ease of comparison, they do not include other variable and manufacturing fixed cost contributions. As noted in the manuscript, the cost of base metal dopants in the studied promoter catalysts is < ~0.1 $/kg and is therefore rounded up when reporting estimated values.