INDAdept\textsuperscript{G} Technology for Deep Desulfurization of Gasoline

by

S. Kumar
IndianOil R&D Centre Faridabad, India
Issues in producing ULSG
Options for Gasoline Desulph.
INDAdpt^G Process
Breakthrough Curve
SO₂ Removal options
Present status
Summary
Issue in producing ULSG

- Minimum octane loss
- Minimum yield loss
- Minimum hydrogen consumption
- Capability to economically produce ULSG

Conventional hydrotreating results in saturation of total olefins and higher octane loss.
Options for Gasoline Desulphurization

Achieve desulphurization with min. octane loss

- Separate octane contributors (LCN) by fractionation followed by HDS of remaining stream (HCN) - (Selective HDS)

- Compensate for the octane loss due to HDS by isomerization of saturated hydrocarbons - (Non-selective HDS)

- Adsorption (physical/ reactive)

TECHNOLOGIES: PrimeG, OATS, SCANfining, CDHydro, ISAL, OCTGAIN, S-Zorb, INDAdept
INDAdept Process

Features

- Ideal for deep desulphurisation of gasoline/diesel
- Proprietary adsorbent in hydrogen environment
- ‘S’ removed by cleavage of C-S bond followed by reactive adsorption
- Two reactors operated in swing mode of adsorption and regeneration
- Adsorbent regenerated by oxidation of ‘S’ to SO$_2$ in presence of lean air-nitrogen mixture
INDAdept Process

Mechanism of Adsorption & Regeneration
Feed/Product Properties:

Ideal for S reduction from 1000 to < 10 ppm

- RON reduction of 1-2 units
- H₂ consumption ~ 0.2 wt%
- Suitable for treating Coker/ FCC gasoline
- Employs single reaction step
INDAdeptG Process

Flow Diagram

Feed

H₂ → Reactor

Reactor → Separator

Separator → Recycle Compressor

Recycle Compressor → Flash Drum

Flash Drum → Product

Lt. Gases
INDAdept® Process
Regeneration Flow Diagram

Water Separator
Make-up H₂

O₂/CO₂/CO Analyzers

Recycle gas

H₂ / HC Analyzers

Make-up Air

Caustic/ Amine Activation

Combustion

Separator

Water

Scrubber/SRU

Water wash column

Make-up Caustic/ Amine

Flare

H₂ / HC/ O₂ Analyzers

Purging

CBD

Fuel gas

Feed Storage

Depressurization

Make-up H₂

N₂

N₂/O₂

N₂/H₂
INDAdept G Process

Regeneration Cycle

- Automatic Reactor swing mechanism & necessary safety interlocks
- Oxidation & activation steps conducted with compositions below lower inflammability limit. Further purging introduced before these steps
- Typical Regeneration Cycle (4-8 days, Temp: 400 – 500 °C)
INDAdept\textsuperscript{G} Process

Reactor swing operation

Feed/ \( \text{H}_2 \)

\( \text{N}_2 \)

\( \text{N}_2/\text{O}_2 \)

\( \text{N}_2/\text{H}_2 \)

HC/\( \text{H}_2/\text{O}_2 \) Analyzers

Adsorption

Activation

Combustion

Purging

\( \text{H}_2 / \text{HC}/\text{O}_2 \) Analyzers

Depressurization
Gasoline Desulphurization

Feed = 60% Coker Gasoline + 40% FCC Gasoline
Feed 'S' = 1080 ppm
Feed Olefins = 26.5 wt%
SO$_2$ Removal/ Disposal Options

- Caustic Scrubber
- Integration with SRU
Process developed after Extensive pilot plant data generated during last 7 years

Scale-up & Commercialization along with Design & Engg. Consultant (EIL)

Adsorbent scale up & commercialization with Catalyst Manufacturer (Sud-Chemie India Ltd.)

Demonstration unit of 35 TMTPA is under consideration in one of IOC’s Refineries for reduction of sulfur content in Heavy FCC gasoline from 1000 to 10 ppm
Summary

- Lower consumption of H$_2$ (0.12 - 0.25 % of feed) in INDAdept$^G$
- Process can be used by refineries to meet EURO-IV and EURO-V specifications
- Lower Plant & Machinery cost
- Lower octane loss
Thank You