"REFINERIES – PERSPECTIVE FOR CLEANER AUTO FUELS"

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Agenda

- Auto Fuel Quality Improvement
- Specifications as per Auto Fuel Policy
- Preparedness for meeting Euro-III / IV norms
- Way forward - Future concern

Diesel Quality Improvement

Year	Cetane No.	Sulfur Content (wt)	Distillation ^{0}C (max.)
1995	45	1.0 %	370 @ 90%
1996	45	0.5 % (NCR + Selected cities)	- Do -
1999	45	0.05 % (NCR, limited supply)	- Do -
2000	48	0.25 % (Nationwide)	370 @ 95%
2005	48	500 ppm (BS II; nationwide)	- Do -
2005	51	350 ppm (BS III; selected cities)	360 @ 95%
2010	51	350 ppm (BS III; nationwide)	- Do -
2010	51	50 ppm (Euro IV; selected cities)	- Do -

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MS Quality Improvement

1995	Second Revision of IS 2796	Anti Knock Index and Vapour Lock index incorporated
Mar 1997	Amendment No. 1	Specs for unleaded gasoline incorporated
Mar 1999	Amendment No. 2	87 RON MS lead content reduced from 0.56 to 0.15 g/l. Further reduced to 0.013 g/l in 2000.
March 2000	Amendment No. 3	Benzene content reduced for metros to 3 % Volume Max, 1% in NCR / Greater Mumbai
Sep 2000	Amendment No. 4	RON spec incorporated, in addition to AKI
2005	Amendment No. 5	Sulfur : 150 ppm, Benzene 1% BS III in selected cities
2010		Sulfur: 50 ppm, Benzene 1% Euro IV selected cities

Major Changes in Specification of Diesel

Parameter	Pre BIS 2000	BIS-2000	BS-II	BS-III	Euro-IV
Sulphur, wppm	10000	2500 / 500	500	350	50
Cetane No.	45	48	48	51	51
Cetane Index, CI	-	-	46	46	48
Distillation ^{0}C at 95% max	-	370	370	360	360
Polycyclic Aromatics, wt% max	-	-	-	11	11

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Major Changes in Specification of Gasoline

Parameter	Pre BIS 2000	BIS-2000	BS-II	BS-III	Euro-IV
Sulphur, wppm	2000 (leaded)	1000/ 500	500	150	50
Benzene, vol%	5.0	5/3	3	1	1
Aromatics, vol%	-	-	-	42	35
Olefins, vol% (Regular/Premium)	-	-	-	21/18	21/18
RON (Regular/Premium)	87	88/93	88/93	91/95	91/95

Euro IV from April 1, 2010 in 4 Metros & 9 major cities, BS III in rest of the country

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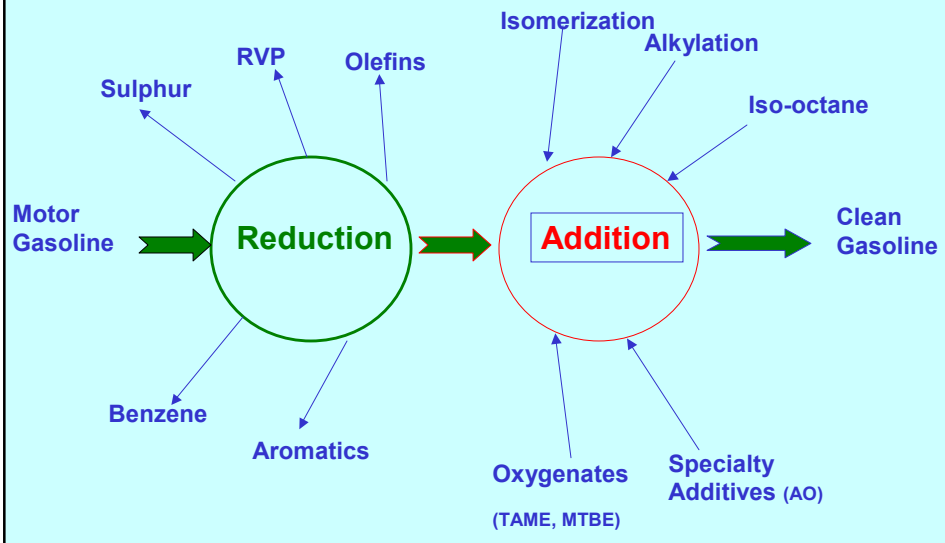
Production of Clean Motor Gasoline



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MS Blending Components in Refineries

S.No.	Process Unit	MS Component	Characteristics
1	Catalytic Reformer	Reformate	High in RON, Benzene & Aro. Low in Sulfur
2	FCC	FCC Gasoline	High in RON, Sulfur & Olefins Low in MON
3	Crude Distillation	LSRG	Low in RON
4	Hydrocracker	Light & Heavy Naphtha	Low in RON & Sulfur
5	VBU & DCU	Cracked Naphtha	Low in RON High in Sulfur & Olefins

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Fuel Quality Improvement – Challenges

Gasoline	Diesel
Sulphur reduction	Sulphur reduction
Octane increase	Cetane increase
Reduction of olefins	Reduction of Recovery & density
Reduction of Benzene & Aromatics	Poly-aromatic control

Existing system inadequate for meeting Euro IV specifications.

New technologies, revamps & augmentation required by refineries.

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Steps taken for MS Quality Improvement

I. **Benzene Reduction :** *From 5% in 2000 to 1 % in 2005*

- Cut point adjustment for CRU feed
- Reformate splitting into Light reformate (rich in Benzene) & Heavy reformate (low in Benzene)
  - Hydro-isomerisation of Light reformate
  - Direct routing of Hy. Reformate to MS
- Reformulation of blends (e.g. addition of isomerate)
- Installation of Isomerisation unit.

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Steps taken for MS Quality Improvement (contd.)

II. Sulphur / Olefin Reduction

- Addition of Sulphur reduction additives to reduce FCC Gasoline Sulphur
- FCCU feed (VGO) De-sulphurisation
- Cut adjustment of FCC Gasoline
- More incorporation of Hydrocracker Naphtha
- Withdrawal of VBN & Coker Naphtha from MS
- Installation of CRU / CCR.

III. Stream sharing between Refineries and absorption of Petrochemical Return Stream

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HSD Blending Components in Refineries

S.No.	Process Unit	HSD Component	Characteristics
1	FC C	TCO	High in Sulfur Low in Cetane High PAH
2	Crude Distillation	Gas Oil	Crude specific
3	Hydrocracker	Gas Oil	High in Cetane Low in Sulfur
4	VBU & DCU	Cracked Gas Oil	High in Sulfur Low in Cetane

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Efforts for HSD Quality Improvement

I. Sulphur Reduction:

- Addition of 2nd Reactor in all DHDS Units
- Revamp of existing DHDS / change of Catalyst
- Adjustment in operating conditions of process units

II. Cetane Improvement:

- Installation of DHDT Units
- Installation of Hydro-Cracker units
- Addition of Cetane additives

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Technologies to improve Diesel Quality

Technology	H2 partial press. (bar)	Improvement in quality
DHDS	35 +	Sulphur reduction of SR gas oil and TCO
DHDT	85 +	Reduction in 'S', Gain in cetane coupled with T 95 point correction
Hydro-cracker	140 +	Maximise Middle distillate along with Cetane improvement and very high sulfur reduction

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Efforts for HSD Quality Improvement (contd.)

III. HSD Recovery

Standard	Recovery @ T95 in Deg C	Density Kg/M3
BS II	370	820-860
BS III / IV	360	820-845

1. **Short term measures**

   Adjustments of operating conditions in CDU.

2. **Long term measures**

   Major investments with tower internals, additional draw and associated facilities.

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Financial Impact to meet - BS-II / III / Euro-IV

BS- II / III Production

- Investment over Rs.15,000 Crore for the refineries.
- Increase in production cost by approx.Rs.1.00 per litre

…. *Figures as on 2004*

BS-III / IV Production

- Investment over Rs.25,000 Crore for the refineries.
- Increase in production cost by approx.Rs.1.50 per litre (BS III)

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Impact on Refinery operation

1. Increase in Energy consumption & Op. Cost (DHDS):
   - Power 16.06 KW/MT, Steam 7 T / MT of Diesel processed
   - Operating Cost : Rs 700 /MT
2. Impact of T-95 recovery at 360 Deg C for HSD & disposal of Heavy ends from the Crude unit
3. Space limitation in refineries for new facilities
4. Shrinkage in flexibility of operations w.r.t. crude mix, processing capacity and product slate.

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Preparedness for BS III / IV

Major Investments for MS

New facilities	Refinery
• Isomerisation • NHDT, HGU • Naphtha splitter	IOC – Guwahati / Digboi / Barauni / Panipat / Koyali
• FCC Gasoline De-sulphurisation • CRU Revamp • Reformate & FCC Gasoline Splitter	IOC – Barauni / Panipat / Mathura

BS III for entire country, Euro IV for 4 Metros & 9 cities from April 2010

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Preparedness for BS III / IV (contd.)

Major Investments for MS

New facilities	Refinery
• New CCR • FCC Gasoline Splitter	BPCL-Kochi
• New CCR	BPCL – Mumbai
• Conversion of CRU to CCRU • New ISOM Unit	CPCL

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Preparedness for BS-III / IV Facilities

Major Investments for HSD

New facilities	Refinery
Installation of 3rd Reactor in existing DHDT Change of catalyst in all Reactors	IOC - Barauni
New DHDT and Hydrogen unit	Gujarat
Once through Hydrocracker unit and Hydrogen unit	Haldia
Installation of 2nd stage Reactors in DHDT	Panipat

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Preparedness for BS-III / IV Facilities (contd.)

Facilities being developed (HSD)

New facilities	Refinery
Installation of DHT	HPCL – Mumbai / Vizag
Integrated Diesel / VGO Hydrotreater	BPCL – Mumbai
Euro III – VGO HDS	BPCL-Kochi
Installation of DHDT and change of catalyst in DHDS	CPCL

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Issues to be considered for recommending 10 ppm sulphur Auto Fuel

1. Benchmark existing pollution levels and benefit accrued by implementation of BS III / Euro IV emission norms.
2. Benefits to be established/ quantified before recommending 10 ppm Sulfur Auto Fuels.
3. Compensation to Refiners such as Custom Duty waiver, concessional excise duty and higher depreciation considering the project as environment- friendly
4. Multi-product pipeline operation -Interface material will have to be reprocessed in nearest Refineries.

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Alternative Clean Fuels

Other Fuels that can augment the production of clean fuels from Indian refineries are:

Immediate	Long Term
Ethanol	Gas to Liquid Fuel (GTL)
Bio Diesel	Coal to Liquid Fuel (CTL)
Auto LPG / CNG	

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Conclusion

- Quality of Auto Fuels has moved towards global standards.
- Positive impact on the air quality w.r.t SO_2, NOx, CO_2 and PM.
- Refineries making huge investment to upgrade fuel quality to EuroIV standard. Return on Investment in these mega projects to be re-looked.
- Development of alternate clean fuels for long term energy security and sustainability.

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CPCL
Thank You
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