AUTOMOTIVE GAS OIL

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### AUTOMOTIVE GAS OIL

#### COMMON TERMS

- **Fossil Fuels**
  - From Organic Matter Over Millions of Years (Natural Gas, Crude Oil, Coal, Peat etc)
  - Extracted from Underground
  - Mainly Composed of Hydrogen & Carbon

- **Hydrocarbons**
  - Refers to Liquid Oil & Gas

- **Oil & Gas**
  - Industry Commercially Dealing in Oil & Gas

- **Crude Oil**
  - Main (Oil) Commodity Traded Before Refining

- **Gasoline** .. Means Petrol
- **Distillates** .. Kerosene & Diesel

#### CRUDE OIL

- Raw Material For Petroleum Refineries
- Mixture of Hydrocarbons with Small Amount of Sulphur, Nitrogen Salts & Water
AUTOMOTIVE GAS OIL

- Crude Oils Different & Classified According to:
  - Source - Murban, Arab Light Etc
  - Sulphur Level - Sweet - Low Sulphur
    - Sour - High Sulphur
  - Composition - Paraffinic - High Wax
    - Naphthenic - Low Wax

REFINING

- Crude Oil Limited Processed into Petroleum Products
- Treatment or Enhancement of Quality of Product
  - Removing Sulphur or Addition of Blending Components to Improve Quality.
AUTOMOTIVE GAS OIL

Crude oil flows through a process that involves:
- Atmospheric distillation
- Catalytic cracking
- Hydrocracking
- Lube oil plant
- Thermocrack/Visbreaking
- Coking
- Hydroconversion

These processes lead to the following products:

- Propane/Butane
- Light gasoline
- Naphtha
- Kerosene
- Gas oil
- Atmospheric residue
- Vacuum distillates
- Vacuum residue

The diagram shows the separation, conversion, removal of impurities, and upgrading processes leading to various products including:

- LPG
- Naphtha
- Gasoline
- Jet fuel
- Diesel
- Lube oil
- Fuel oil
- Asphalt
AUTOMOTIVE GAS OIL – AGO

• **INTRODUCTION**
  – “Diesel” - Smoke-belching Trucks & Clattery, Smoking PSVs (Matatus).
  – Engine Technology Minimized Noise & Vibration
  – Remaining Major Demerit: Emissions Quality:
    • Fumes - “Dirtier”
    • Smoke Unpleasant

• **TERMINOLOGY**
  – “Diesel” - Derived from German Inventor Rudolf Diesel
  – Invented Diesel Engine in 1892

• **PETROLEUM DIESEL**
  – Complex Mixture of Hydrocarbons
  – Heavier & Oilier - Evaporates Slower than Gasoline
  – Higher Boiling Point than Water
  – Contains More Carbon Atoms C 8 – C22
  – Combustibility of Diesel Fuel Characterized by Cetane Number:
AUTOMOTIVE GAS OIL – AGO

• Ability to Undergo Compression Ignition
• Higher Cetane Number Fuel Ignites Readily
  – Demand for AGO has Risen due to Increased Industrialization & Construction in China & India
  – Unless Special Processing Done, Distillate Fractions Contain Sulphur in Proportion to Sulphur Content of Crude Oil
  – To Produce Low Sulphur Fuel, Refineries Adapted to Extract Sulphur
    • Hydrogen Available for Sulphur Removal
    • Distribution Infrastructure Installed – Separate LSD from Regular Diesel

• COMPRESSION ENGINE
  – Diesel Engine Uses a Four-stroke Combustion Cycle.
  – Four Strokes are:
    • Intake Stroke
AUTOMOTIVE GAS OIL – AGO

– Intake Valve Opens Up, Letting in Air & Moving Piston Down.

  • Compression Stroke
    – Piston Moves Back Up & Compresses Air.

  • Combustion Stroke
    – As Piston Reaches Top, Fuel is Injected at Just Right Moment & Ignited - Forcing Piston Back Down

  • Exhaust Stroke
    – Piston Moves Back to Top, Pushing Out Exhaust Created from Combustion

• Diesel Engine has No Spark Plug - Intakes Air & Compresses It - Injects Fuel Directly into Combustion Chamber (Direct Injection)

• Heat of Compressed Air Lights Fuel in Diesel Engine.
AUTOMOTIVE GAS OIL – AGO

• ALTERNATIVES
  – BIODIESEL
    • From Plant & Animal Sources
  – SYNTHETIC DIESEL
    • Produced from Carbonaceous Material:
      – Biomass
      – Biogas
      – Natural Gas
      – Coal.
    • Raw Material Gasified into Synthesis Gas, After Purification Converted to Synthetic Diesel:
      – Biomass to Liquid (BTL)
      – Gas to Liquid (GTL)
      – Coal to Liquid

• CRITICAL SPECIFICATIONS
  – Cetane Number - Min 48
  – Flash Point - Min 66 Deg. C
# AUTOMOTIVE GAS OIL — AGO

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distillation</td>
<td>Rec @ 365 Deg. C, FBP</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Maximum 0.05 %</td>
</tr>
<tr>
<td>Viscosity</td>
<td>1.6 – 5.5 Cst</td>
</tr>
<tr>
<td>Cloud Point</td>
<td>Max 12</td>
</tr>
<tr>
<td>Cold Filter Plugging Point</td>
<td>Max 6 deg. C</td>
</tr>
<tr>
<td>Sediment</td>
<td>Max 0.01</td>
</tr>
<tr>
<td>Water</td>
<td>Max 0.05</td>
</tr>
<tr>
<td>Ash</td>
<td>Max 0.01</td>
</tr>
<tr>
<td>Carbon Residue</td>
<td>Max 0.15</td>
</tr>
<tr>
<td>Total Acid Number</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**USES**

- Used for Diesel Injection Engines:
  - Light & Heavy Vehicles
  - Locomotives
  - Marine Boats
  - Power Generators
AUTOMOTIVE GAS OIL – AGO

• Pumps
• Mills

- Heating Oil in Colder Climates

• TRANSPORT POLLUTANTS
  - Diesel Combustion Exhaust Major Source of Atmospheric Soot & Particles
  - Particulate Matters (PM)
    • Fine Particles Emitted from Combustion
    • Sulfur Dioxide, Nitrogen Oxides & Organic Compounds
    • PM2.5 are Fine & Can Penetrate Deep into Lungs
    • Fine Particles Remain in Atmosphere for Days & Travel Many Kilometers
    • Asthma, Decreased Lung Function, Heart Attacks & Premature Death
    • Diesel PM are Carcinogens
  - Hydrocarbons (HC)
    • From Incomplete Burning of Fuel
    • Can React with Nitrogen Oxides to Form Ozone
AUTOMOTIVE GAS OIL – AGO

- Can Cause Cancer & Other Adverse Health Effects
  - Sulphur Oxides (SOx)
    - Sulphur Present in Fuels
    - Contributes to Respiratory Illness (Children & Elderly)
    - Aggravates Existing Heart & Lung Diseases
    - Destroys Aesthetics
    - Deterioration of Air Quality
    - Acidification of Soil & Water
    - High Levels of Sulphur Prevent Use of:
      - Catalytic Diesel Particulate Filters to Control Particulate Emissions
      - Use of Advanced Technologies - Nitrogen Oxide Absorbers
  - Nitrogen Oxides (NOx)
    - Nitrogen Present in Fuels
    - Reacts with Hydrocarbons to Form Ozone which Causes Serious Respiratory Diseases
AUTOMOTIVE GAS OIL – AGO

- Forms Acid Aerosol which Cause Respiratory Problems

  - Carbon Monoxide (CO)
    - From Incomplete Combustion of Fuels
    - Poisonous at High Levels in Air
    - Affects Central Nervous System - Affects Persons with Heart Problems

  - Ozone (O3)
    - Ground Level Ozone is Product of Reaction Between Hydrocarbons & Nitrogen Oxides in Presence of Sunlight
    - Causes Variety of Health Problems
    - Permanent Lung Damage After Long Exposure

- WITHOUT EMISSION CONTROLS

  - Reducing Sulphur Reduces SO2 Emissions & Particle Emissions.
  - SO2 from Combustion Oxidized to SO3 - Dissolves in Water Vapour Form Sulfuric Acid (H2SO4)
  - Sulphate Particles Account for Large Fraction of
AUTOMOTIVE GAS OIL – AGO

- Increased Particle Toxicity.

• Reducing Sulphur in Diesel Lowers Total PM Emissions & Toxicity

**WITH EMISSION CONTROL**

- Diesel Oxidation Catalysts (DOC)
  • Most Common After Treatment Emissions Control Technology in Diesel Vehicles.
  • Increase Oxidation Rate of SO2, Leading to Increases in Sulphate Nanoparticle Emissions.

- Diesel Particulate Filters
  • Continuously Regenerating Diesel Particulate Filter (CR-DPF) & Catalyzed Diesel Particulate Filter (CDPF)
  • Achieve 95% Efficiency in Removal of Carbonaceous PM
  • Efficiency Drops with Increase in Sulphur
  • With LSD, Diesel Particulate Filters Provide Effective Control of
AUTOMOTIVE GAS OIL – AGO

- Particles
- Particulate Filters Also Provide Effective Control of CO & HC Emissions
  - NOx Control Systems
    - NOx Absorbers
    - Selective Catalytic Reduction (SCR) Systems
      - Store Sulphur.
      - Engine Tuned for Low PM & High Fuel Economy.
  - Retrofit Technologies
    - Where Low Sulphur Fuel Available, Retrofit Technologies Reduce Emissions
    - Oxidation Catalysts & Particulate Filters

CLEAN AIR AGENDA

- Driven by Requirement for Clean Air for Health & Environmental Protection
- Governments have Obligation to Citizens to Prepare Clean Air Laws & Regulations
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- NEMA has Finalized Air Quality Regulations & Standards
- Efforts Through UNEP Catalyzing Action by Countries
- Focus Mainly Urban Due to Concentration of Transportation

CLEAN FUELS
- Fuels with Low Sulphur & Nitrogen Levels.

CLEAN VEHICLES
- With Technology to Remove Particulate Matters
- Emissions Control Systems for Diesel Vehicles
  Technology Works with Fuels with Sulphur Below 500 ppm.
- Well Maintained to Burn Fuels Efficiently

URBAN TRANSPORT PROGRAMS
- Reduce Traffic Congestion & Engine Idling
- Reduce Number of Vehicles in Urban Areas Through Public Transport Rationalization.
AUTOMOTIVE GAS OIL – AGO

KENYA SULPHUR STATUS

- KEBS Specification is 5000 ppm (0.5%)  
- Imported Diesel has 5000 ppm (0.5%) or Less  
- KPRL Production is 10,000 ppm (1.0%)  
- South Africa 500 ppm (0.05%)  
- Target for Post KPRL Upgrade is 50 ppm (0.005%)  
- European Standard is 15 ppm (0.0015%)  
- Low Sulfur Diesel < 50 ppm  
- Ultra Low Sulfur Diesel is 15 ppm

SULPHUR REDUCTION

- Move to LSD Aimed at Lowering Diesel Engines’ Harmful Exhaust Emissions & Improving Air Quality.  
- Low Sulphur Required to Enable Operation of Advanced Emission Control Devices  
- LSD will Work with New Generation of Engines:  
  - Meet Strict Emission Standards  
  - Emissions-reducing Devices
AUTOMOTIVE GAS OIL – AGO
- Emission Standards & Preferential Taxation
- Forced Reduction of Sulphur
  - Transition to LSD
  - Reducing Sulphur also Decreases Acids Formed in Engine Combustion Chambers - Extended Engine Life.
  - Target 500 ppm - Threshold for Diesel Vehicle Emission Technology
    - Upgrade KPRL Sulphur Removal Processes – Target 50 ppm or Less
  - Target 2000 ppm for Imported Diesel
- BIO-DIESEL
  - Two Categories:
    - Bio-diesels - Blend of Vegetable Oil & Petroleum Diesel in Varying Proportions
      - 5% Blends Common.
    - Bio-Ethanol – Blend of Alcohol Produced from Bio-mass with Mineral Gasoline.
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– Blend Ratios Vary:
  » Government Standards & Regulations
  » Vehicle Design or Retrofits
  » Blend-stock Availability
  » Economics.

  • United Kingdom
  • Brazil
  • USA

JUSTIFICATION FOR BIO-DIESEL
• Social Economic Development - Small Scale Growers & Users.
• Alternative Fuel
  • National Energy Security
  • National petroleum imports substitution
  • Where & When Cheaper Alternative
AUTOMOTIVE GAS OIL – AGO

- Cleaner Fuel
- Reduced Air Pollution (No Sox, NOx, PMs)
- Greener Fuel with Reduced Greenhouse Gases (CO2)
- Carbon Credits Through Direct Exports or Local Certification
- Environment - Increased Vegetation Cover

CHALLENGES
- World-wide Supplies Should Increase.
- Sulphur Reduction Technologies More Available
- Capital Investment to Upgrade Refineries
- Prices for LSD May Remain High

OPPORTUNITIES
- Lower Harmful Emissions
- Reduced Number of Early Deaths due to Pollution.
- Upgrade Engines - Compatible with Cleaner Fuel
Small Company

• The Nice Thing About Working in a Small Company is That When I Don’t Know What I’m Doing, At Least My Co-workers and Clients Do.
AUTOMOTIVE GAS OIL

ANY QUESTIONS?