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Addressing Base Oil Color and Stability Issues Using UOP HPNA RM™ System Adsorption Technology

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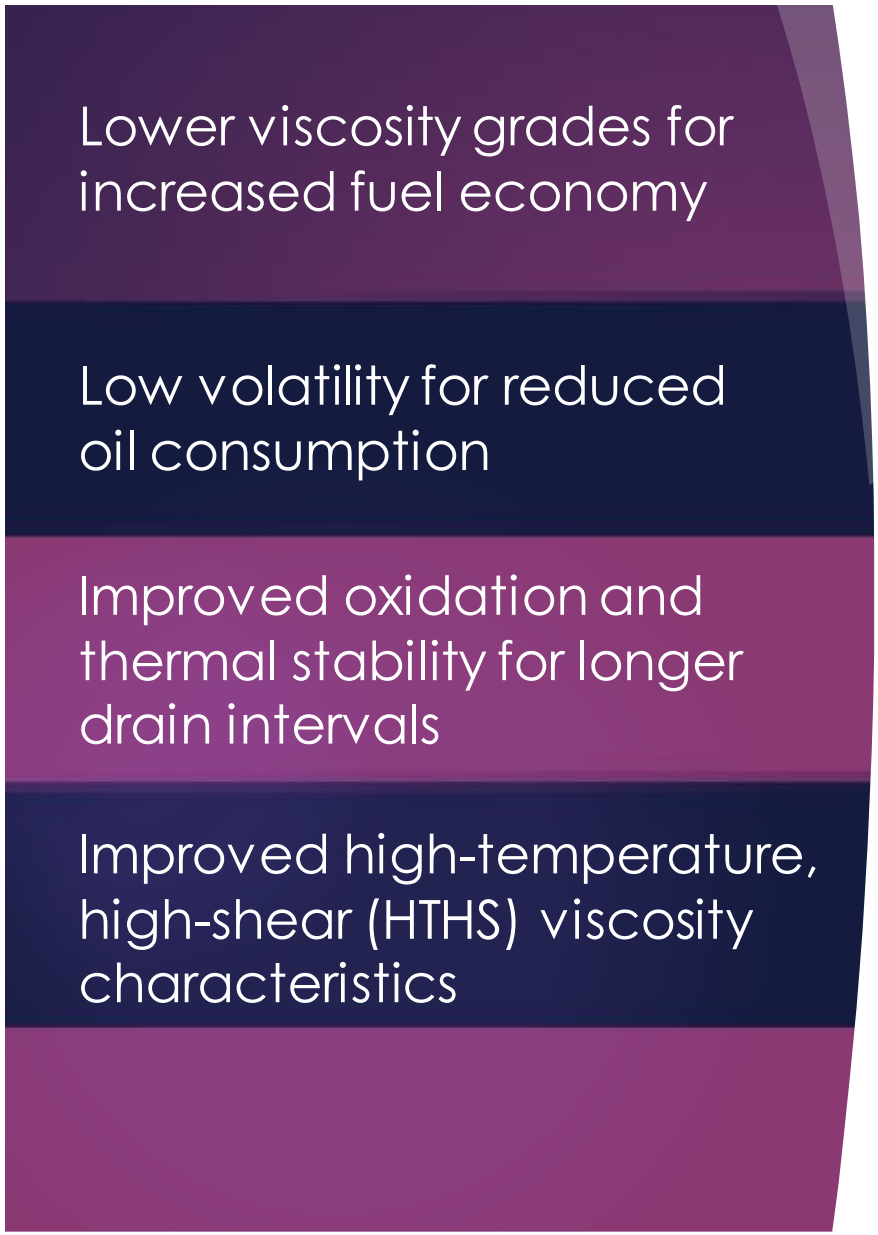
Presentation Outline

- Trends in lubricant industry
- Role and challenges of Hydrocracking in base oil production
- Issues faced by base oil producing refineries
- UOP troubleshooting and possible solutions
- Key takeaways

Trends In Lubricants

- Through out the world, increased focus on fuel emissions and fuel economy
- Significant investments by OEM's to develop high performance engines
- Lubricant requirements for engine oils shifting towards lower viscosity multi grades (5WXX,0WXX)
- Surge in demand for high Viscosity Index (VI) and high quality base oils to meet the revised stringent specifications
- Significant global shift to all hydroprocessed Group II and III base oils



LEGISLATION

OEM'S

CONSUMERS

LUBRICANT MANUFACTURERS

MARKET FORCES DRIVING THE USE OF HIGH QUALITY BASE OILS

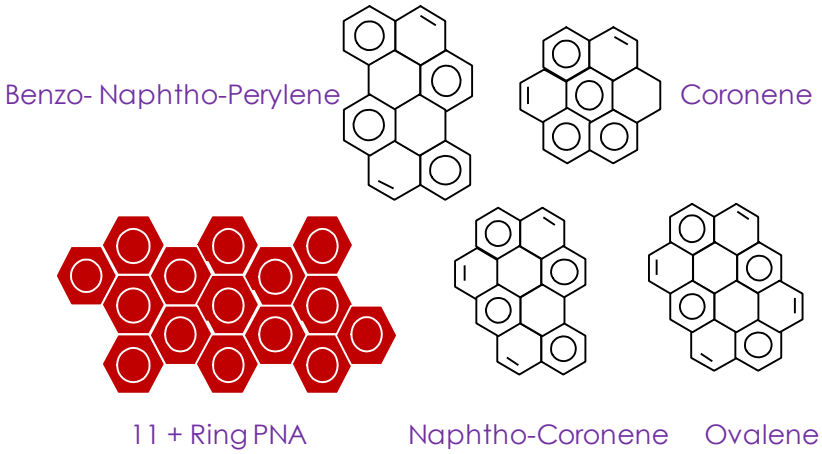
Role Of Hydrocracking

- Well suited process technology for production of high quality Unconverted Oil (UCO) - feedstock for lube base oil production
- Flexibility to operate in either lube or lubes-fuels co-production modes while processing a wide variety of feedstock
- Produces higher yields of better quality base oils that exhibit excellent response to commercial additive packages
- Base oil VIs from Hydrocracker can vary from 115 to >140
- Ultra low contaminant contents of UCO helps in production of base oils with better color, oxidation and thermal stability

By-product Of Hydrocracking

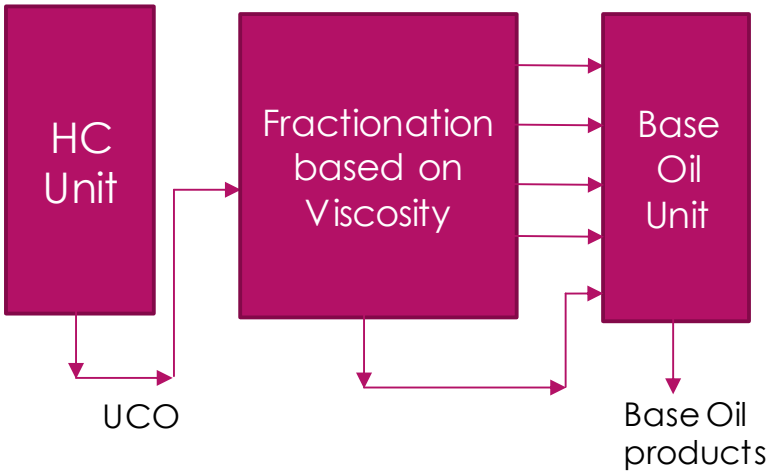
- Heavy polynuclear aromatic compounds (HPNAs)
- 7+ fused aromatic rings
- Small amounts (ppm levels) formed depending upon HCU configuration and operating severity
- Production increases with increasing catalyst temperature

Typical HPNAs Found in Recycle Oil



Challenges of Dealing with HPNAs

- PNAs / HPNAs present in UCO can end up in either light or heavier base oil products based on the viscosity
- If not managed properly, may lead to color degradation and/or oxidation stability issues in base oil products
- More critical in production of heavier grades (6 - 12 cSt)
- HPNAs concentrates in the heaviest base oil product



Problem Identification

- UOP approached by a few refineries to troubleshoot base oil product color (<25+ Saybolt) and oxidation stability issues
- Analytical testing of multiple base oil product samples carried out to identify cause
- Visually no difference between "good" and "bad" color samples - Colorless

29	24	25	28	28	27
Saybolt Color					

Basis for UOP Solution – Internal Analysis

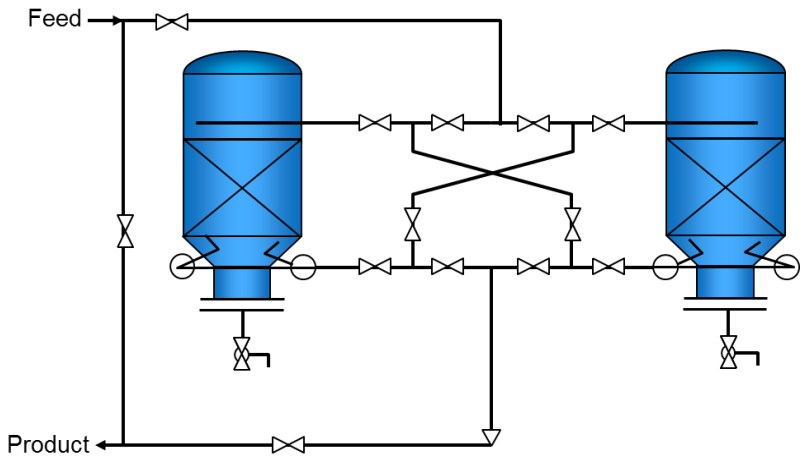
- UOP HPNA test methods showed no presence of HPNAs
- Other internal test results revealed "bad" color base oil products had some specific color causing compounds than "good" color base oil products

Basis for UOP Solution – In-House Test Method

- Identification of compounds masked by the vast number and complex nature of compounds present
- Development of an in-house characterization technique to unveil the complex nature of hydrocarbon mixtures and identify color causing bodies
- New analytical technique helped in isolating the color causing bodies in base oil products

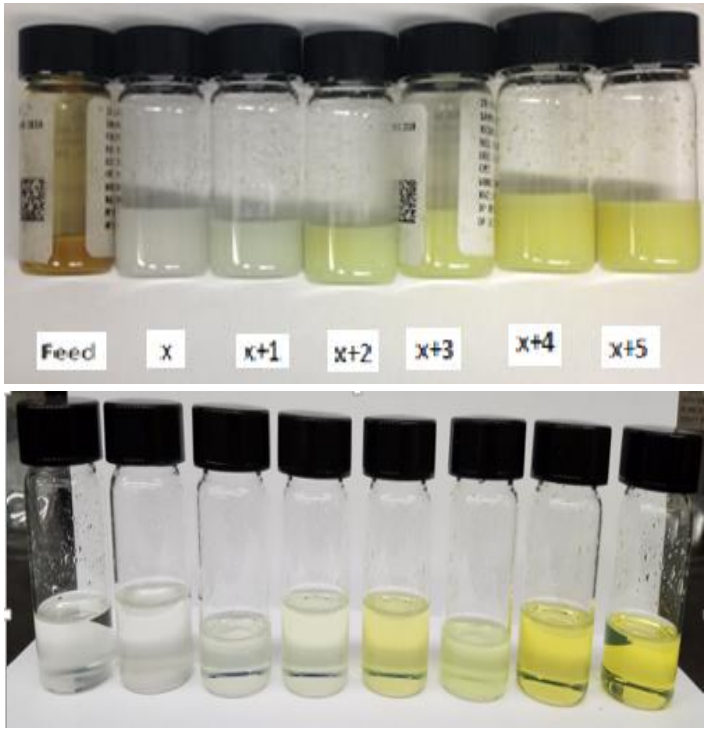
UOP's HPNA RM™ System

- Main challenge to remove compounds imparting color to base oils
- Pilot plant study to determine applicability of UOP's HPNA RM™ System carbon adsorption module
- Testing carried out with waxy feed to the base oil plant
- Step out cases done to identify the optimum operating conditions / location for best utilisation of carbon beds



Carbon Bed Test Results

- All products lost the brown / orange color of the feed after passing through carbon bed
- Good color improvement seen in product – off white to lemon yellow



Experience With Carbon Beds

- Eleven running commercial units with HPNA RM™ System adsorption technology to manage HPNAs in UCO
  - South East Asian Refineries – 5 Units
  - India Refineries – 2 Units
  - United States Refineries – 4 Units
- One unit in operation for removing color and stability issues in lube application

Key Takeaways

HPNA RMTM System Adsorption Technology May Help Manage Base Oil Quality Throughout The Catalyst Life To Address Color And Stability Issues

Depending on PNA / HPNA management requirements, the adsorption modules can be either installed at the front end or back end of base oil plant to target specific components