

REVOLUTIONARY TECHNOLOGY SOLUTIONS



FOR A CHANGING WORLD


PROCESS DYNAMICS
I N C O R P O R A T E D

PROCESS DYNAMICS, INC.

is a cutting edge provider of advanced technology solutions for the refining industry. Their breakthrough hydroprocessing technology provides a proven cost-effective approach for meeting today's more stringent product requirements. Creating the industry standard for dewaxing, deoiling and debottlenecking lube oil plants, Process Dynamics' focus lies in developing technologies and process innovations that address specific needs of the petroleum refining industry while reducing capital and operating costs.

The traditional means of meeting severe requirements is to use the "big hammer" approach; use higher pressure, more catalyst volume, more recycle gas, etc. By re-examining the chemical and process fundamentals, Process Dynamics has developed an alternative to the "big hammer," offering hydroprocessing technologies for nearly every application using smaller reactors and much less hydrogen compression equipment, resulting in the most cost-effective approach for any application. Whether the product is ultra low sulfur diesel or food-grade oils and waxes, Process Dynamics' IsoTherming™ technologies can offer cost-effective solutions for the most stringent product requirements.

IsoTherming™ Applications

- Ultra-Low Sulfur Diesel
- Heavy Cat and Coker Naphtha
- Pretreating Catalytic Cracker Feedstocks
- Mild Hydrocracking
- Hydrocracking
- Lube and Wax Hydrotreating

Advantages

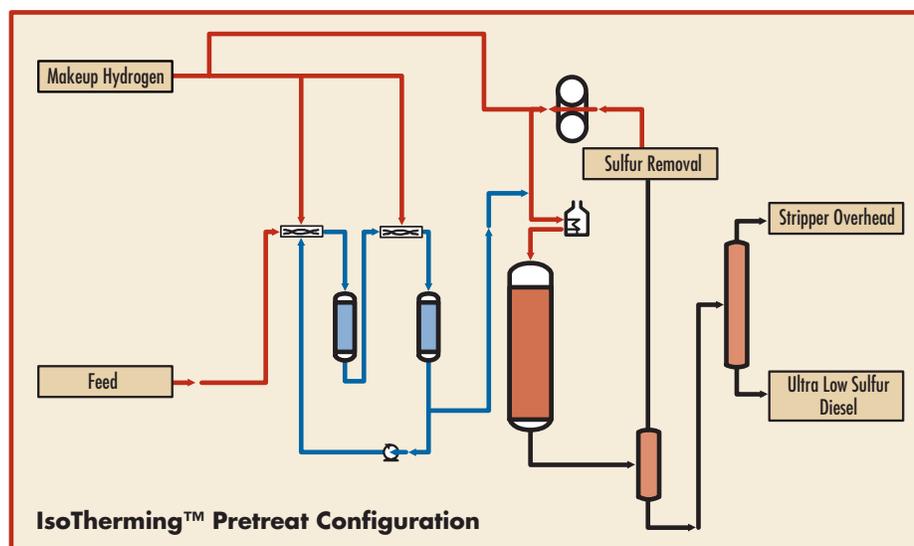
- Lowest capital alternative
- Longer catalyst life
- Lower hydrogen consumption than conventional catalyst technology
- No reduction in product endpoints is necessary
- Nearly complete nitrogen removal
- Cetane increase
- Applicable in existing low-pressure units



IsoTherming™ reactor in first commercial ultra low sulfur diesel unit, Gallup, NM.

DIESEL ISOTHERMING

Process Dynamics' revolutionary new IsoTherming™ technologies for fuels hydroprocessing provides the most effective, cost-efficient solution to the clean fuels challenge. The IsoTherming™ technology allows refiners to meet the ultra low sulfur requirements at both reduced capital and operating costs, compared to competing technologies. Process Dynamics provides the ONLY Ultra Low Sulfur Diesel unit in the United States for meeting the 2006 diesel sulfur standard of 15 ppm from a mix of cracked stocks and straight run distillate. No reduction in diesel endpoint is necessary, and the technology can be integrated into existing low pressure units.



IsoTherming™ Pretreat Configuration

The integration of the IsoTherming™ Pretreat Configuration into an existing conventional hydrotreating unit is illustrated in this simplified diagram.

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Installation of the first commercial IsoTherming™ unit.



IsoTherming™ recycle pumps.



Rendering of the first commercial license of Process Dynamics integrated solvent extraction/dewaxing technology.

The IsoTherming™ technologies and strategic manufacturing partnerships provide a total solution at costs of up to 75 percent lower than conventional technology. The process can be either adapted to an existing hydrotreater by simply adding one or more small reactors and minimum additional equipment, or may be installed as a new grass roots unit.

Industry Drivers:

- Meets mandated sulfur requirements
- Minimal capital investment
- Minimum plot requirements
- Minimum impact on operating cost
- Minimum impact on current operations
- Product improvements where possible

SOVENT BASED LUBE TECHNOLOGIES

Process Dynamics offers a complete slate of solvent based technologies for lube and wax production. The revolutionary new process combines solvent extraction and solvent dewaxing into a single processing unit utilizing common solvents resulting in dramatically reduced operating costs. In addition, with the much more selective solvent system used by Process Dynamics, refin-

ers can expect yield increases in finished lube oils of 5 to 20 percent, depending on the stock, or increased product quality at the same yield.

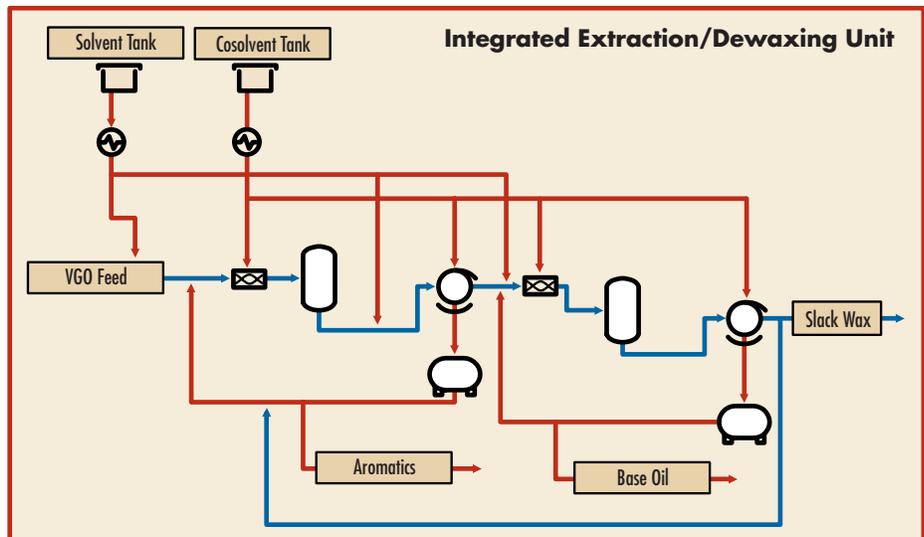
Coupled with Lube and Wax IsoTherming™ technology, refiners can produce Group II+ base oils with higher yields and lower costs than they currently experience for conventional Group I base oils.

EXTRACTION/DEWAXING COMPARISONS OF 90 SUS STOCK

	Furfural/MEK	Process Dynamics	
		A	B
Raffinate Yields, Vol%	53	50	71
Dewaxed Oil Properties:			
Vis @ 40° C, cSt	16.5	15.5	14.1
Viscosity Index	92	112	101
Pour Pt., °F	5	5	5
Mildly-Hydrotreated Viscosity Index		120	110

Comparisons of Process Dynamics' extraction/dewaxing results with Furfural/MEK extraction/dewaxing. Run A compares dewaxed oil properties based on similar raffinate yields. Run B shows product properties at higher yields.

Integrated Extraction/Dewaxing Unit
Using a common solvent system allows for the complete integration of the extraction and dewaxing units into a single unit.



des the ONLY Ultra Low United States for meeting standard of 15 ppm from a and straight run distillate.

REVOLUTIONARY TECHNOLOGY SOLUTIONS FOR A CHANGING WORLD

Process Dynamics, Inc. based in Fayetteville, Arkansas, was founded in 1993 for a new solvent based lube and wax extraction technology. Two years later the company became a client of Genesis Technology Incubator, a business incubator affiliated with the University of Arkansas, and there developed IsoTherming™, a new hydroprocessing technology that removes sulfur and nitrogen from most all petroleum feedstocks. A partnership was formed in 2001 with Linde BOC Process Plants to market and build IsoTherming™ technology to industry. The first successful commercial IsoTherming™ unit for producing ultra-low sulfur diesel fuel was completed in April 2003 at the Giant Industries refinery in Gallup, New Mexico.

Process Dynamics is a technology development company, primarily in the petroleum refining industry, and has technologies for hydroprocessing of fuels and manufacture of lube base oils and waxes. Process Dynamics, in conjunction with its partners, markets its clean fuel technology under the IsoTherming™ trademark. The IsoTherming™ technology is applicable to both diesel and naphtha hydrotreating as well as cat feed pretreatment. Process Dynamics' other hydrotreating technologies have application to the wax and lube finishing for value added base oils and USP grade waxes and oils. Process Dynamics also offers a solvent based technology for the manufacturing of lubes and waxes that combines the extraction, dewaxing, and deoiling into a single unit while improving dewaxed oil product yields and quality. Process Dynamics continues to expand their technology base through research and development activities, and licenses its technologies through targeted partnerships and the wholly owned licensing subsidiary, PD Licensing, LLC.

FIRST COMMERCIAL UNIT - GIANT INDUSTRIES' GALLUP, NM REFINERY

Process Dynamics, Inc. has successfully proven its IsoTherming™ technology for full-scale commercial production of ultra-low sulfur diesel three years in advance of EPA mandated reductions in diesel sulfur standards. In April 2003, Process Dynamics' revolutionary hydrotreating technology, IsoTherming™ was fully implemented into Giant Industries' Gallup, NM refinery and began producing diesel containing less than the 15 ppm sulfur mandate. Using a feed consisting of 40 percent cracked stocks, sulfur was reduced to 4 ppm in the product stream and nitrogen was below detection at less than 1 ppm. In addition to sulfur and nitrogen removal, the process also reduces aromatic content and dramatically improves the diesel cetane.



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