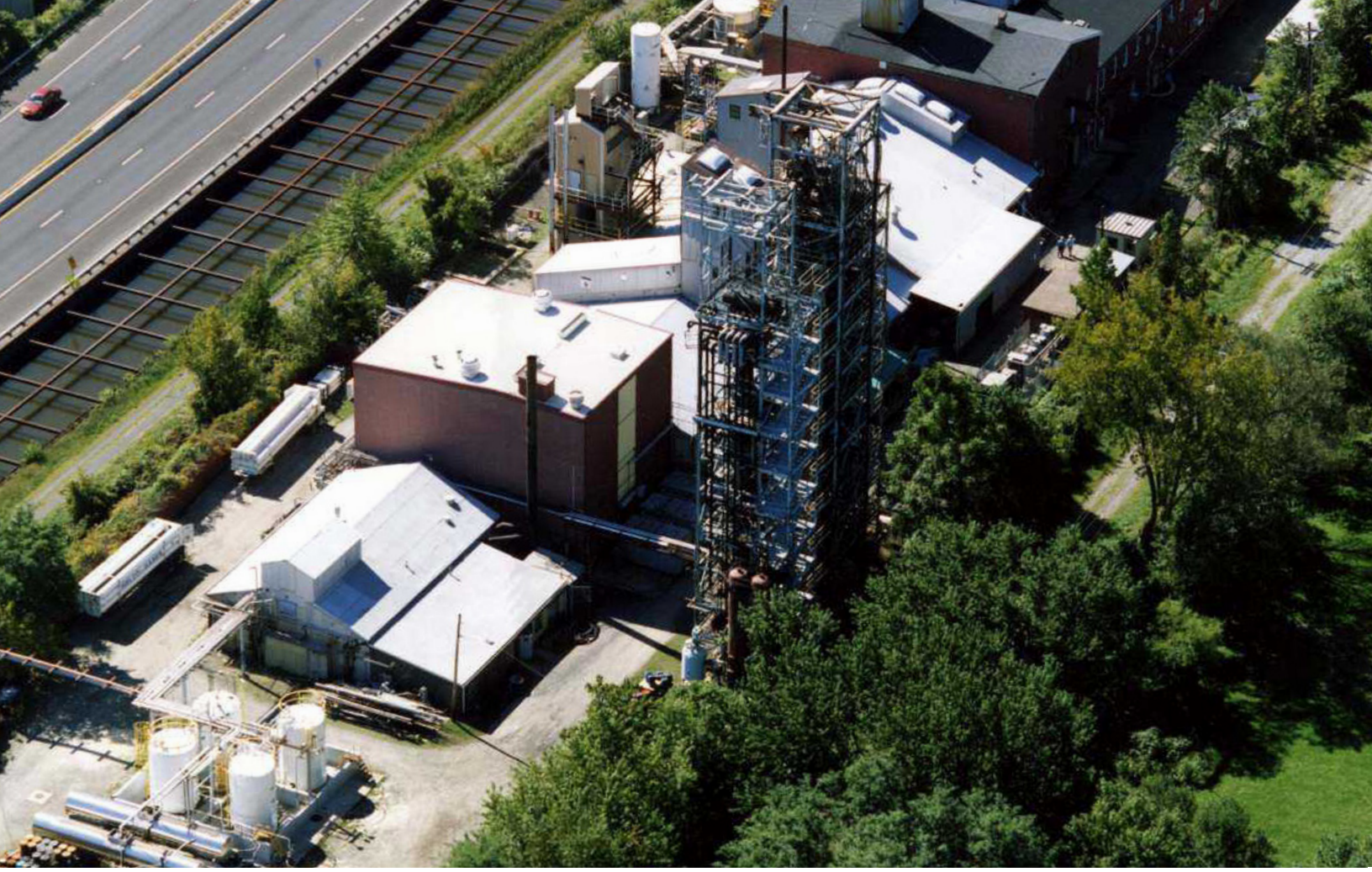

The world leader in unique catalysts and technologies that provide energy products from low-value feedstocks.

hti

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HTI is developing a portfolio of catalytic process technologies, expanding the HCAT dispersed-catalyst hydrocracking platform to include Direct Coal Liquefaction and other technologies featuring nanotechnology-enhanced catalysts. These technologies are supported by a team of scientists, engineers, technicians, and specialists with expertise in petrochemical and refining processes, coal conversion, precious-metal catalysis and nanotechnology.

COVER: The HTI R&D Center covers more than 40,000 square feet, comprising laboratories, pilot plants of a variety of sizes and configurations, and a "mini-refinery" process development and demonstration unit capable of up to 30 barrels-per-day of refinery process simulation. The HTI staff is a mix of qualified and industry-experienced scientists, engineers, refinery specialists and technicians, whose expertise covers the development, scale-up and design of chemical, petrochemical and oil refining processes. Roughly half the professional staff have advanced degrees in engineering and/or chemistry.

HTI's diversified facility includes extensive analytical laboratories, pilot-scale catalyst manufacturing equipment and process modeling capabilities, in addition to the pilot plant operating units, all of which meet or exceed all environmental and safety standards.

HCAT® Hydrocracking Technology. A breakthrough in heavy oil upgrading.

The HCAT® Hydrocracking Technology represents a breakthrough in heavy oil upgrading. While processes for converting the so-called "bottom of the barrel" into higher-quality syncrudes have been in use for almost a century, HCAT is the first to utilize a simple, two-phase (liquid and gas), hydrocracking reactor system. The earliest such technologies relied on "thermal cracking" – using high temperature to break down large molecules into smaller ones – while later processes used hydrogen addition, with solid catalysts, to better control the quality of the products and to minimize production of unwanted byproducts. These solid catalysts, typically a combination of two or more transition metals on an alumina support base, are limited by their physical structure as to the amount of heavy oil they can process and the quality of the product slate that can be produced.

Until the introduction of Headwaters' dispersed, liquid-phase HCAT catalyst, solid-catalyst hydrocracking in an ebullated bed reactor was considered the state-of-the-art in heavy oil upgrading for both crude petroleum residua and the oil-sands bitumen found in Western Canada. Adding the HCAT Hydrocracking Catalyst into an ebullated bed reactor converts the entire reactor volume – not just the part where the solid catalyst is – into an efficient catalytic hydrocracker.

The HCAT Hydrocracking Catalyst is a single-molecule catalytic agent, chemically generated within the reactor system from a proprietary precursor chemical, introduced with the resid feed. By reducing the catalyst to the size of a single molecule, the reaction system can be optimized for desired reaction – breaking large oil molecules into smaller ones – without having to deal with unwanted side reactions and byproduct formation. In the simplest terms, HCAT enables the refiner to convert more of the residual feed going into the hydrocracker, into higher-value distillates.

With its ability to handle a wide range of feedstocks with different properties, maximizing syncrude yields while minimizing coke and asphaltenic byproduct formation, HCAT is ideally suited for upgrading projects using heavier, less-costly feedstocks, such as those found in Russia, Mexico and Canada.

Commercial Proof:

The technology has been successfully demonstrated on the commercial scale at several different refineries. During a six-week trial at one refinery in Europe:

The operator was able to increase resid conversion by +10% over the course of the trial.

Unconverted bottoms sediment remained within acceptable limits even at higher conversion.

The rate of heat exchanger fouling, a major problem at this refinery, was reduced.

The operator was able to increase resid feed rate by 5 tons/hour without problem.

Fuel oil product quality, as well as distillate yields, were measurably increased.

The plant ran smoothly, reactors remained stable, and EB catalyst management was maintained as it was before the trial began. Plant operations were undisturbed by the addition of HCAT.

The mechanical system for injecting the HCAT catalyst was proven in commercial use.

HCAT® Hydrocracking Technology continued.

Summary:

HCAT offers several significant advantages over conventional upgrading processes:

Non-deactivating molecular-size catalyst, introduced with feedstock.

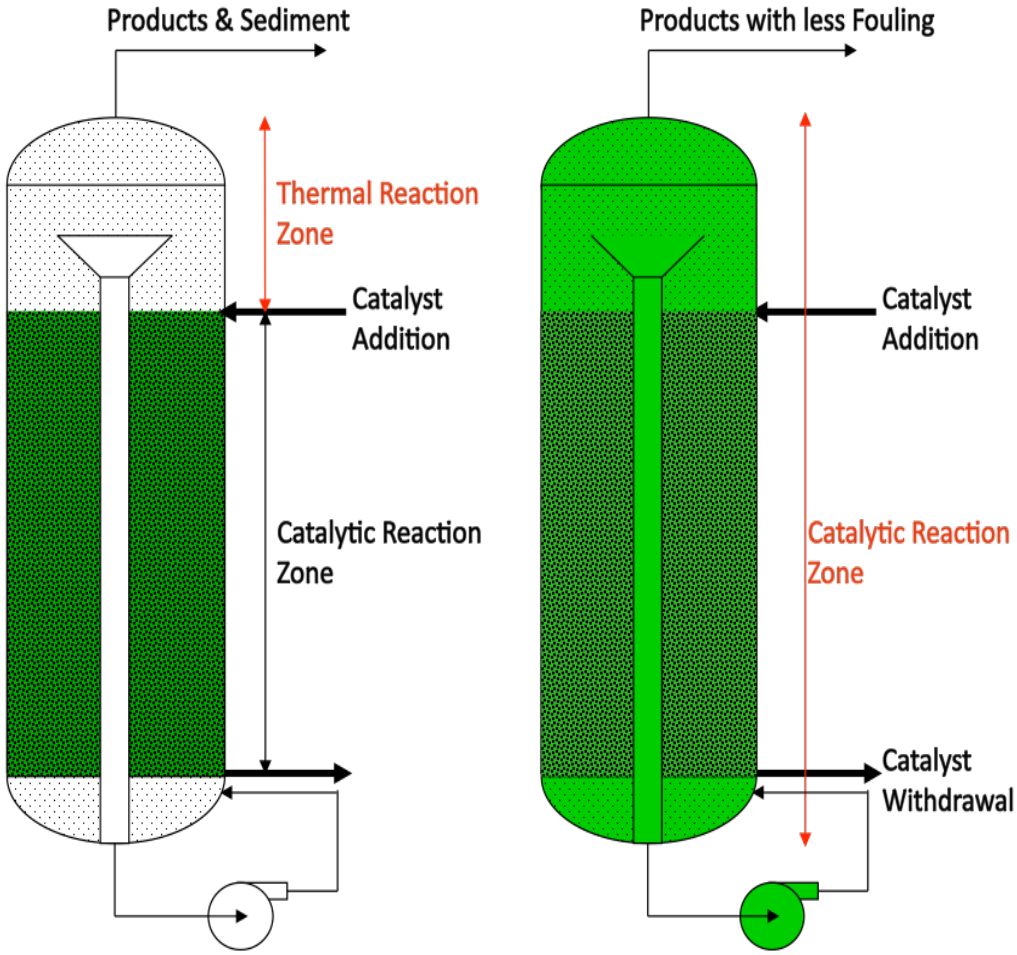
Constant product quality (no catalyst "aging effect").

Feedstock flexibility – HCAT works well across a broad range of residual feedstocks.

HCAT provides flexibility to raise resid conversion without fear of coking / fouling

HCAT provides flexibility to increase upgrading reactor throughput

Potential for reduction in maintenance costs (less fouling, smoother operation)



The ebullated bed reactor has been in commercial use for 40+ years. When HCAT is added, the full EB reactor volume is utilized for the conversion reaction. The solid catalyst can be optimized for enhanced functions such as HDS (desulfurization) and metals removal.

Direct Coal Liquefaction. Converting coal into clean transportation fuels.

HTI has developed a direct coal liquefaction ("DCL") process used for converting coal into ultra-clean transportation fuels, such as gasoline, jet fuel, and diesel fuel. We license this technology internationally. The first commercial DCL plant started up in 2008 in China. In addition, project discussions, feasibility studies and engineering studies are underway for clients in China, India, Indonesia, Mongolia, New Zealand, Russia and the United States.

HTI and Axens formed a strategic alliance ("Alliance DCL") in 2009, to provide a single-source solution for producing ultra-clean fuels by direct coal liquefaction alone or in combination with refinery residues or biomass. The two companies have combined their technologies and licensing activities for Coal-to-Liquids ("CTL") projects world-wide.

HTI brings its slurry catalyst technology and its exclusive CTL research facilities. Axens contributes its ebullated-bed H-Coal® Process and proprietary catalyst. Both evolved from a common background and DCL technologies developed by Hydrocarbon Research Inc. ("HRI"), which were commercialized with support from the U.S. Department of Energy and industrial clients. Building on decades of experiences in DCL and a database on a wide range of coals, both companies have continued to increase liquid yields, improve energy efficiency, lower production costs and reduce the environmental footprint (CO2 emissions and water consumption). Both companies provided technology packages and basic engineering contributing to the successful start-up of the first commercial DCL plant in China.

Axens also provides coal-liquids upgrading technologies necessary to achieve finished fuel specifications.

Project-Specific Services:

To maintain quality, Alliance DCL offers a wide range of project-specific services to support licensing of our DCL technologies, including:

Feasibility studies
Feedstock characterization
Pilot plant testing
Basic engineering design
Operator training
Start up assistance
Catalyst supply
Plant audits and troubleshooting
Ongoing technology support

NxCat®. HTI's Next Generation Catalyst Technology.

The NxCat nanotechnology platform was developed by HTI to control the formation of particles at the nanometer scale. Using proprietary molecular or polymer templates, HTI is able to design and engineer catalysts as well as other nanomaterials at the molecular level. Materials produced with the NxCat technology exhibit the following advantageous features:

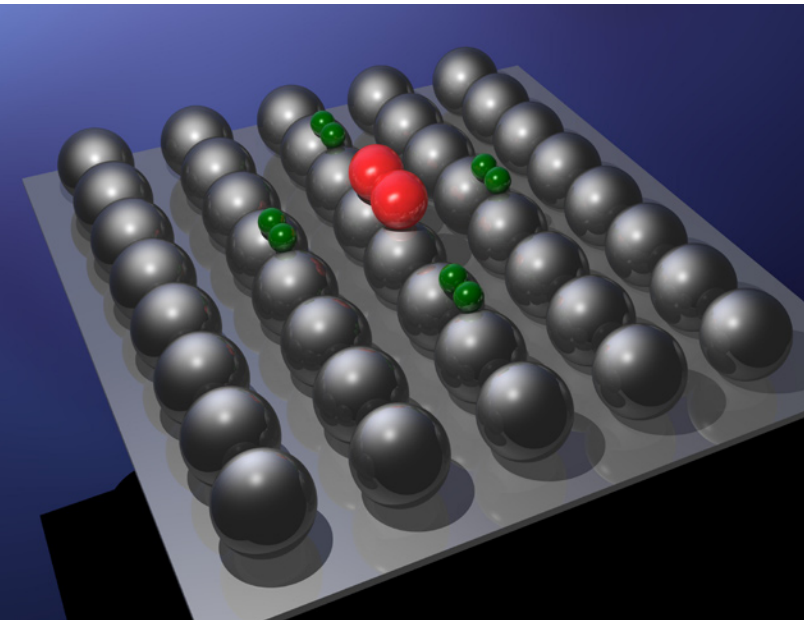
1 Control of nanoparticle size

2 Control of nanoparticle composition

3 Exposure of preferred catalyst surface structure

4 Uniform dispersion of nanoparticles

5 Nanoparticles are anchored to support (base) material



HTI's NxCat Catalyst is engineered to exhibit the "1-1-0" crystal orientation of its active catalyst metals, enabling the direct synthesis of hydrogen peroxide from hydrogen and oxygen, with little or no formation of water as a byproduct.

Conventional catalyst manufacturing processes have limited control over these fundamental features. With most commercial catalysts, only one or two of these features are well- controlled, and often not at the nanometer scale. HTI's NxCat nanotechnology provides a new way to not only control each individual feature, but to create the correct combination and interaction amongst these fundamental and important features.

The application of HTI's unique nanotechnology in the catalysis field can have a significant impact on the refining, chemicals and related industries. A new generation of highly efficient NxCat nanocatalysts could someday replace conventional ones. New, cutting-edge catalytic processes based on HTI nanocatalysts will be simpler to operate, more economically attractive and, most importantly, better for the environment. NxCat chemistry will produce the desired end-product with fewer, possibly zero, unwanted byproducts.

HTI has applied these features to the development of next-generation nanocatalysts for gasoline production and chemicals manufacturing. Two of these potential future commercial products have already been scaled up from the laboratory to commercial demonstrations, using catalysts produced at HTI in metric-ton quantities, as follows:

1 Six tons of platinum-containing NxCat nanocatalyst were used in a commercial naphtha reforming unit at a Utah refinery for over a year. During that year-long trial, the refinery observed a measurable increase in octane (RON) and total liquid yield, both of which resulted in a higher return from gasoline sales.

2 A one-ton demonstration of a supported precious-metal nanocatalyst for the direct synthesis of hydrogen peroxide was carried out with Evonik Chemical Co. (formerly Degussa A.G.) in Germany. The unique chemical process made possible by HTI's NxCat catalyst enabled very high yields of hydrogen peroxide (H202), with very little byproduct formation. HTI was honored by the U.S. government for this catalyst's contributions to the field of "green chemistry".

HTI: A Brief History of Unique People and Resources.

1943 Hydrocarbon Research Inc. was founded.

1964 Company was acquired by Dynalectron (now DynCorp)

1988 Company was acquired by Husky Oil Inc.

1995 Research Center became an employee-owned company; name was changed to "Hydrocarbon Technologies Inc."

2001 Company was acquired by Headwaters and the name was changed to "Headwaters Technology Innovation" and finally shortened to HTI.

SOME OF THE TECHNOLOGIES INVENTED AND/OR COMMERCIALIZED AT THE HTI R&D CENTER:

Ebullated bed reactor ("H-Oil", "H-Coal")

Catalytic Two-Stage Liquefaction ("CTSL") – Direct Coal Liquefaction

Partial Oxidation (forerunner of GE's Gasification Process)

Thermal Hydrodealkylation – toluene-to-benzene technology

HCAT® Heavy Oil Hydrocracking

HTI's UNIQUE PEOPLE AND RESOURCES

Technology-Based Commercialization Specialists

Most employees with 15-30 years' energy/chemicals experience

Demonstrated understanding of scale-up from R&D to "real world" projects

Hands-on engineering, design and operational experience:

Heavy oil upgrading (H-Oil and related processes)

Coal-to-liquids (H-Coal, CTSL, HTI DCL, Fischer-Tropsch, etc.)
Aromatics and other petrochemical processes
Catalyst development / screening / QC testing
"Cryogenic" scrubbing of refinery off-gas for recycle
Processing of lignin to liquid product
Jet fuel from shale oil
Starch hydrolysis
Waste Stream Upgrading

R&D CENTER

Site Covers nearly 6 acres

Buildings contain over 40,000 s.f. of office and research space

Southern section is located in Trenton (economic development zone)

Northern section is located in Lawrenceville (NJ's "Einstein's Alley" for high tech companies)

HTI: Process Units.

OVERVIEW OF PILOT PLANTS

Over 20 separate process units.

Batch & Semi-Batch Operations from gm scale to kg scale

Continuous Operation from 1 kg/day to 30 bbl/day (25,000kg/day)

Operation at commercial conditions: Up to 850F (454C) and 2750psi (190bar)

Units operating as fixed bed, CSTR or ebullated bed reactors

Catalyst production capability for up to one-ton batches

CSTR TEST UNIT

Two stage unit with two 1-liter stirred reactors

Continuous heavy oil and hydrogen feed

Heavy oil / dispersed catalyst feed prepared off-line or direct injection of dispersed catalyst

Off-line vacuum separation allows vacuum bottoms recycle

Off-line pressure filtration

Continuous product separation

Commercial pressures, temperatures, space velocities

Processes 5 to 20 kg /day

BENCH SCALE TEST UNIT

Two stage unit with two 430 cc's plug flow reactors

Reactors can be operated in upflow or downflow mode as fixed beds or with dispersed catalyst

Quench gas available

Continuous heavy oil and hydrogen feed

Feed prepared off-line

Off-line vacuum separation allows vacuum bottoms recycle

Off-line pressure filtration

Continuous product separation

Commercial pressures, temperatures, space velocities

Typically processes 2 to 12 kg /day

HTI: Process Units continued.

PILOT SCALE TEST UNIT

Two stage unit with two 3-liter back mixed reactors which can be operated as up-flow, down-flow, fixed bed or ebullated bed

Continuous heavy oil and hydrogen feed

Heavy oil/dispersed catalyst feed prepared off-line

Continuous product separation

Continuous atmospheric distillation

Off-line vacuum separation allows vacuum bottoms recycle

Direct injection of dispersed catalyst

Commercial pressures, temperatures, space velocities

Processes 10-50 kg/day

Two identical pilot units which can be coupled allowing up to 4 reactor in series

Interstage separation available

On-line hydrotreating available

PROCESS DEVELOPMENT UNIT PDU

Two stage unit with two 300-liter back mixed reactors which can be operated as up-flow, down-flow, fixed bed or ebullated bed

Continuous heavy oil and hydrogen feed

Feed prepared on-line

On-line catalyst addition and withdrawal

Continuous product separation

On-line atmospheric and vacuum distillation

Vacuum bottoms recycle

On-line hydrotreating

Recycle gas with fuel oil scrubbing

Commercial pressures, temperatures, space velocities

Processes 5-30 bbl/day

H2S absorber for off gases

Fired heaters

Analytical Capability & Typical Reporting On Tests.

25 AUTOMATED/COMPUTER CONTROLLED PROCEDURES

Over 70 Total Procedures

Over 40 ASTM Procedures

OVER 70 INTERNAL PROCEDURES

NEW METHODS ADDED AS REQUIRED

TYPICAL DAILY ANALYTICAL ON PRODUCT STREAMS

API Gravity

Distillations (D-86, D-1160, SimDis)

CHNS all streams (Leco and Antek available)

Ash

Metals (ICP or AA)

CCR

Refinery Gas Analysis

IP-375 Sediment

Insolubles (Quinoline, Toluene, Heptane, Pentane)

FULL PRODUCTION CHARACTERIZATION

TBP distillation of total product

Full product workup on fraction (ie. PIANO, aromatics, insolubles, etc…)

TYPICAL DAILY RESULTS REPORTED

Resid Conversion

Asphaltene Conversion

CCR Conversion

Product Yields

Hydrogen Consumption

Heteroatom Removal

All Operating Parameters (T, P, SV, catalyst age, etc…)

The mission of HTI, a wholly-owned subsidiary of Headwaters Incorporated, is to be a world leader in the area of unique catalysts and technologies for providing energy products from low-value feedstocks. HTI's core technology, the HCAT® Process, is a proprietary and patented method for hydrocracking heavy residual oil. Beyond HCAT, HTI offers unique coal-to-liquids conversion technology and holds patents on a broad range of nanotechnology-based catalysts and catalytic processes. Common features of HTI's technologies are energy efficiency and "green chemistry" – that is, avoidance of unwanted byproducts and low environmental impact.

The HCAT Technology was initially demonstrated as an add-on to ebullated bed upgrading units around the world. It enhances overall unit performance by enabling higher conversion, lower sediment and higher-quality products than were previously possible in ebullated beds. The finely distributed and dispersed HCAT hydrocracking catalyst enables more efficient and complete cracking of the asphaltenic components of heavy vacuum residua and bitumen than was previously possible. HCAT has been successfully demonstrated in refinery trials in Europe and North America.

For more information contact: HCAT@headwaters.com

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