

***THE WORLD'S LEADING SUPPLIER
OF ENVIRONMENTALLY FRIENDLY
CATALYST SERVICES***



TOTSUCAT® SULFIDING AND PASSIVATION

Patented encapsulation technology completely seals each TOTSUCAT® activated catalyst particle. TOTSUCAT® with EZload® is delivered in supersacks/big bags with handling and loading the reactor in air.

Discover more about EZload® at ezload.eurecat.com



Totsucat® G for Naphthas • Totsucat® TG for Tail Gas • Totsucat® SG for Syngas

When to use Totsucat® G, TG, and SG

Preactivation: For units that are difficult to start up due to operational restrictions, units where optimum sulfiding cannot be achieved, and/or units where minimal start up time is economically beneficial. Typical Applications: NHT, Gasoline Post-treat, Tail Gas, Lube, Hydrogen PlantHDS, and Sour Gas Shift units.

Operational Conditions: Totsucat® G, TG, and SG have no sulfur requirement for the feed. Start-up can be in liquid phase or gas phase.

Gas recirculation is not required since the catalyst is totally preactivated. Unit temperature restrictions are not an issue.

Handling and Loading Conditions:

Preactivated catalysts are packaged in drums or flowbins. Standard form is non-passivated and must be loaded under inert conditions. Passivation allows for loading under air.

**Type of Start-Up:
Load & Go™**

Totsucat® E for Cat Feed HT, Diesel HT (Use Totsucat D for ULSD Catalysts)

When to use Totsucat® E Preactivation: Where there is sufficient sulfur in the feed and the desire to minimize start-up time and avoid the problems associated with in-situ sulfiding. Typical Applications: Cat Feed, Low Sulfur Diesel, and VGO hydrotreaters.

Operational Conditions: Totsucat® E requires sufficient sulfur in the feed (at least 0.5 wt%) to complete activation. Start-up can be liquid

phase or gas phase. Gas recirculation and sufficient unit temperature (600-620°F) to finalize activation of the catalyst is required.

Handling and Loading Conditions:

Preactivated catalysts are packaged in drums or flow-bins. Without passivation, the catalyst must be loaded under inert conditions. Optional passivation allows for handling and loading under air.

Totsucat® N for Hydrocracker Pretreat Catalysts

When to use Totsucat® N Preactivation:

Totsucat® N is designed for sulfiding Hydrocracker Pretreat (HCPT) catalysts. Preactivated catalyst are especially useful for gas phase start-ups. Typical Applications: Hydrocracker Pre-treat catalysts.

Operational Conditions: Totsucat® N has no sulfur requirement for the feed. Start-up can be in liquid phase or gas phase. Gas recirculation is not required since the catalyst is preactivated. Unit temperature restrictions are not an issue.

Handling and Loading Conditions:

Preactivated catalysts are packaged in drums or flow-bins. Without passivation, the catalyst must be loaded under inert conditions. Optional passivation allows for safe handling and loading under air.

**Type of Start-Up:
Load & Go™**

Totsucat® CFP for Any HT Unit Starting with Cracked Feeds

When to use Totsucat® CFP Preactivation:

Where there are benefits to starting up with cracked feed stocks. Totsucat® CFP allows the gradual introduction of cracked feeds during start-up without the 3-4 day delay typically recommended by catalyst manufacturers. Typical Applications: Coker Naphtha or units processing LCO or coker gas oil.

Operational Conditions: Totsucat® CFP has no sulfur requirement for the feed. Start-up can be in liquid phase or gas phase. Gas recirculation is not required since the catalyst is completely activated. Unit temperature restrictions are not an issue.

Handling and Loading Conditions: Preactivated catalysts are packaged in drums or flow-bins. Without passivation, the catalyst must be loaded under inert conditions. Optional passivation allows for handling and loading under air.

**Type of Start-Up:
Load & Go™**

**Start Cracked Feeds
From Day 1**

Totsucat® HC for Hydrocracking Catalysts

When to use Totsucat® HC Preactivation:

Totsucat® HC uses special conditions to carefully sulfide Hydrocracking catalysts. Preactivated catalyst are especially useful for gas phase start-ups. Typical Applications: Hydrocracking Catalysts.

Operational Conditions: Totsucat® HC has no sulfur requirement for the feed. Start-up can be in liquid phase or gas phase. Gas recirculation is not required since the catalyst is preactivated. Unit temperature restrictions are not an issue.

Handling and Loading Conditions: Preactivated catalysts are packaged in drums or flow-bins. Without passivation, the catalyst must be loaded under inert conditions. Optional passivation allows for safe handling and loading under air.

**Type of Start-Up:
Load & Go™**

Totsucat® D for ULSD Catalysts

When to use Totsucat® D Preactivation:

Totsucat® D is optimized for sulfiding the latest generation of high activity catalysts typically used in ULSD applications. Typical Applications: ULSD hydrotreaters.

Operational Conditions: Totsucat® D has no sulfur requirement for the feed. Start-up can be in liquid phase or gas phase. Gas recirculation is not required since the catalyst is completely activated. Unit temperature restrictions are not an issue.

Handling and Loading Conditions: Preactivated catalysts are packaged in drums or flow-bins. Without passivation, the catalyst must be loaded under inert conditions. Optional passivation allows for safe handling and loading under air.

**Type of Start-Up:
Load & Go™**

Totsucat + Passivation® ♦ Air Loading of Totsucat®

Totsucat+Passivation®: Allows for loading of Totsucat® sulfided and activated catalysts under air. Eliminates inert loading requirement for standard Totsucat® Passivation for air loading available for NiMo, CoMo, NiCoMo, NiW and Ni catalysts Totsucat® CFP with optional Passivation for loading under air EURECAT offers on-site loading and start-up assistance.

START UP HYDROCRACKERS WITHOUT AMMONIA INJECTION

AVOID AMMONIA AND SULFUR INJECTION DURING HYDROCRACKER START-UPS

Temperature excursions are always a risk when starting up a hydrocracking unit loaded with fresh catalyst. To minimize the risk, ammonia is often injected during the sulfiding process. The addition of extra nitrogen from the ammonia passivates the hydrocracking catalyst, reducing the risk of exotherms as the cracking catalyst reaches operating temperature levels. However, ammonia addition exposes operations personnel to a potentially hazardous material and slows the start-up process. EURECAT has developed a method to eliminate the need for ammonia injection.

Our newest offering, Totsucat® HC-AP, combines the patented Totsucat® Activation and Sulfiding process with a special “acid protection” step, which uses nitrogen to passivate the acidic sites. With Totsucat® HC-AP, the catalyst will be sulfided and the acidic cracking sites will

be protected from hyperactivity that can lead to exotherms. By treating your catalysts with Totsucat® HC-AP prior to loading, complicated and time consuming sulfiding steps are no longer required, and the dangers of ammonia injection can be totally avoided.

In a previous start-up of their hydrocracker, a Midwest refiner experienced difficulties injecting the proper amount of ammonia into the unit that was needed to passivate the cracking bed. For their 2012 start-up, this refiner selected Totsucat® HC-AP treatment for their hydrocracking catalyst and combined that with Totsucat® N to sulfide and activate their hydrocracking pretreat catalyst. The Totsucat® treatment enabled the unit to reach normal SOR temperatures within 36 hours of oil in without any exotherms.

CATALYST SERVICES

TOTSUCAT PREAMBINATION: Allows the fastest and safest start-up possible.

SPECIALTY REGENERATION AND REJUVENATION: Get >95% activity from Special Regeneration and/or Rejuvenation. Our techniques are different than a simple carbon burn.

SAS SERVICE: Only get the “good stuff” back with our Sample, Analyze, and Segregate Service.

CATALYST RESALE: Why buy fresh catalysts when regenerated catalysts with “like-fresh” activity are available?

ACTIVITY TESTING: Don't just rely on surface area and poison levels. With two multi-tube test units, EURECAT now runs 82 activity tests per month to measure the true catalyst activity at ULSD conditions.

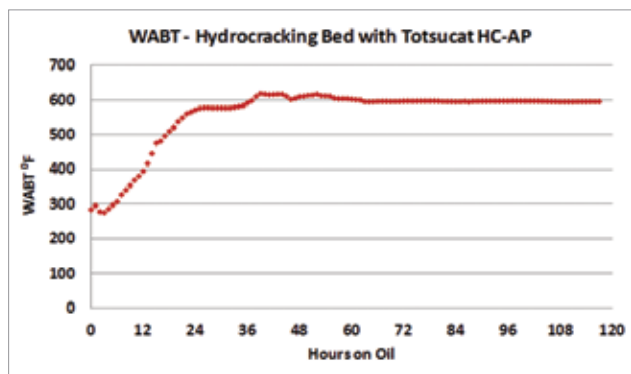
PRESSURE DROP TESTING: EURECAT offers Pressure Drop Testing at our laboratories in the US and Europe. This provides you with real-world ΔP predictions.



Ammonia injection was not required, allowing the refiner to start up their hydrocracker without handling any potentially hazardous chemicals.

HYDROCRACKERS

In these days of high cracking margins, the performance of hydrocracking catalysts is critical to the profitability of the entire refinery, making it crucial that these specialized catalysts are treated with the greatest of care. Processing



with Totsucat® HC ensures that hydrocracking catalysts function as designed without the need to spend valuable production time on in-situ sulfiding. Totsucat® N is designed to maximize the hydrodenitration (HDN) activity of the newest NiMo catalysts typically used in the pretreat section of the hydrocracker.

START UP WITH CRACKED FEEDS

EURECAT has also developed an exclusive procedure to gently moderate the initial catalyst hyper-activity of freshly sulfided catalyst. This unique process, called Totsucat® CFP, allows the direct introduction of cracked or heavy feeds without the 3-4 day delay typically recommended by catalyst manufacturers. Many CFP users have also experienced lower deactivation rates by treating their catalyst with Cracked Feed Protection.

Pre-Activating hydrotreating catalysts with Totsucat® offers many benefits to the refiner including:

- » Load-and-Go reactor start-ups. The active metal sulfides are totally formed during the Totsucat® treatment. No additional sulfiding agents or complex activation procedures are required after loading.
- » No temperature excursions
- » No need for additional hydrogen at start-up
- » Minimal sour water formation during start-up
- » No odors or HSE issues related to the handling of sulfiding chemicals and H₂S.

- » Negligible amounts of H₂S are released during reactor heat up, protecting sulfur
- » Sensitive units downstream and preventing a sulfur overload of your SRU.
- » Starting up with Totsucat®-treated catalysts is similar to a restart after an emergency shut down. Start-up time is reduced to a few hours while the risk of damaging the catalyst prior to activation is eliminated. The catalyst load will achieve peak performance since sulfiding and activation is controlled at very precise conditions by the patented Totsucat® process.

WILL YOUR REGENERATED CATALYST BE A THOROUGHbred AGAIN?



The EURECAT R&D Group has a vast amount of experience with activity testing on hydro-treating catalysts.

Our first pilot plant MDSU was installed in 1996 and was used extensively to determine the HDS activity of regenerated catalysts as part of our pool management services.

The introduction of low and ultra-low sulfur specifications for diesel required testing with increasingly deep HDS regimes. Two new MIF units were purchased in 2003 to carry out testing at these new conditions. The MIF's are still used today, one for HDN activity testing and the other for additional R&D testing.

As HDS activity testing became essential to EURECAT's customers, our testing capacity had to again be expanded to cope with the demand. Our response was the installation of a Multi-Tube test Unit (MTU) which allows testing of 10 samples in 10 parallel reactors of 10 ml each.

The MTU runs a three condition protocol and has proven to be extremely reliable.



Based on this success, a second MTU was installed in 2010, increasing EURECAT's total number of test reactors to 22.

HORSE TRADING

If you don't have a requirement to reuse your catalyst within your own refinery, having it activity-tested by EURECAT will open the door to selling it to an affiliated refinery or to a third party.

EURECAT's catalyst purchase and resale network is shared between our affiliates in the USA, France, Italy, Saudi-Arabia and India. Our worldwide sourcing efforts assure a steady supply and demand for regenerated catalysts. In addition, the catalyst pools we manage for several customers are often in under supply or oversupply of exactly the catalyst that you may wish to sell or purchase.

Contact EURECAT today for a qualified regenerated catalyst and buy a racehorse for a workhorse price.

YOU CAN'T JUDGE A HORSE BY ITS COLOR ANYMORE

The introduction of the latest generation Type II and balanced Type I/Type II catalysts has shaken up the catalyst regeneration universe. Many of these catalysts require post-treatment after regeneration. Unfortunately, the post-regen activity is less predictable using only the data traditionally gathered in a regeneration study such as surface area and contaminant levels. With today's advanced rejuvenation techniques, a critical determining factor for catalytic activity is re-dispersion of the active metals. True catalyst performance is best measured with pilot plant activity testing.

DON'T JUST ESTIMATE THE ACTIVITY, MEASURE THE ACTIVITY

EURECAT can measure both the Hydrodesulfurization (HDS) and Hydrodenitrification (HDN) activity of your regenerated CoMo or NiMo catalyst in our state of the art pilot plants. Expressed as RVA or RWA versus the fresh reference catalyst, the activity value provides you with a sound decision basis.

ACTIVITY TESTING APPLICATIONS

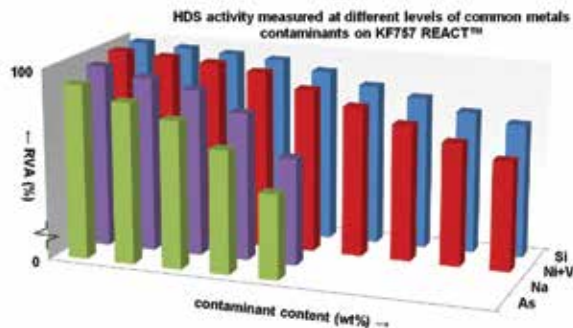
ULTRA LOW SULFUR DIESEL HYDROTREATING

(HDS): The majority of the catalysts we test belong to the ULSD category, where the investment and operational risks associated with regeneration and rejuvenation of the catalyst justify an HDS activity test before the catalyst is reused. Activity testing is an essential and dependable quality control tool, allowing the transfer and reuse of your catalyst batch within the corporate catalyst pool. EURECAT tracks the activity values for various lots in catalyst pools we manage for several major refiners, allowing the customer to carefully manage when and where each lot is applied with minimum risk exposure.

EURECAT's extensive database on activity testing contains a wealth of process and catalyst knowledge. A study (right) carried out by EURECAT assessed the effects of different contaminants on the activity of REACT™ treated KF-757.

Our standard MTU test protocol measures catalyst performance at 3 different levels of severity utilizing straight-run gasoil (1.2 wt% S) at the following conditions:

WABT:	640 / 650 / 660 °F	LHSV:	2 h ⁻¹
Pressure:	580 psi	H₂/oil:	300



HYDROCRACKER / FCC PRETREATMENT (HDN): HDN performance of NiMo catalyst in HC-PT or FCC-PT conditions is tested in a dedicated format on LCO feed at an operating pressure of 1450 psi (100 bar).

NON-STANDARD HYDROTREATING TEST FORMATS: EURECAT will gladly develop a customized testing protocol for your specific process or R&D application. Our MIF testing unit is extremely flexible in terms of operating temperature, pressure, LHSV, and H₂/oil ratio. Various feed types can also be utilized.

HYDROGENATION ACTIVITY / SELECTIVITY TEST: In addition to CoMo and NiMo catalysts, EURECAT can also test your Palladium selective hydrogenation catalysts for activity and selectivity, comparing it to the performance of fresh catalyst. Pilot testing confirms the effectiveness of our exclusive RAISE REACTIVATION treatment.

CHERRY PICK THE “GOOD STUFF” WITH EURECAT’S SAS SERVICE

SAS MAKES SURE YOUR HIGH QUALITY CATALYST IS REUSED AND NOT WASTED

EURECAT’s exclusive Sample, Analyze, and Segregate (SAS) service is the most comprehensive program available for separating good spent catalyst from the “not-so-good”. With this service, a clear contamination profile can be developed, enabling the refiner to “cherry pick” the containers of catalyst that contain clean regenerable catalyst. SAS ensures that only high activity catalyst is regenerated and returned to the customer, while heavily contaminated catalyst is quickly sent out for metals reclamation.

The SAS process begins with labeling and numbering the bins as the spent catalyst is unloaded. Accurate records enable the customer to determine the position of the corresponding spent material inside the reactor. Once the entire catalyst load arrives at EURECAT’s site, samples are sent to our lab for a complete chemical and physical

analysis. The lab report is then consolidated into graph illustrating the contaminant profile and a segregation strategy is implemented.



For catalyst that is deemed as unregenerable, EURECAT will take care of the metal reclaim or ship the unusable portion to a processing site of your choice. SAS can also be used to check the efficiency of your metal traps.

REGENERATION SAS FOR MAXIMIZING REGEN ACTIVITY

CATALYST SERVICES

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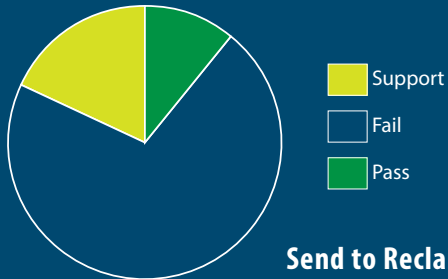
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CASE STUDY: SAS FOR A ULSD UNIT

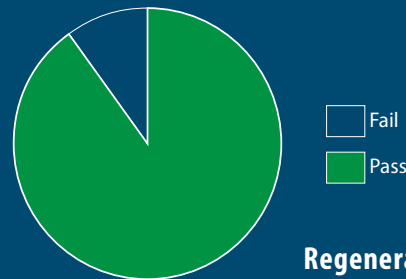
A complete Sample, Analyze, and Segregate (SAS) service was performed on catalyst from a ULSD reactor system with four beds containing a total of 760,000 pounds of CoMo catalyst. The catalyst from the Top Beds of both reactors was vacuumed out, while the Bottom Beds were gravity dumped. All of the bins were numbered in order as the material was unloaded. This allowed EURECAT to create a contaminant metals profile for all of the beds so that the quality of the catalyst from each could be determined.

Visual Inspection of 120K lbs CoMo



Send to Reclaim

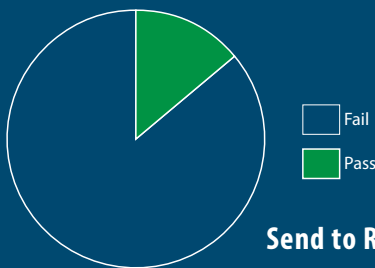
Visual Inspection of 250K lbs CoMo



Regenerated
95% RVA

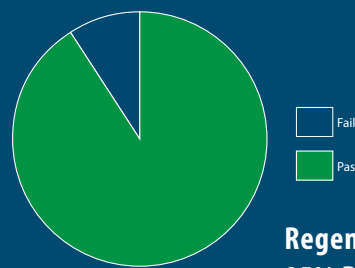
The analysis showed that about one half of the catalyst in the Lead Reactor Top Bed and all of the Lag Reactor Top Bed contained clean catalyst that was suitable for regeneration. Unfortunately, since both Top Beds were vacuumed out, the particle length was much too short for regeneration and therefore all of the material had to be sent for metal reclamation. The Bottom Beds were both successfully rejuvenated, recovering 500K pounds of catalyst with virtually the same activity as fresh ULSD catalyst. The customer achieved another full cycle with no activity or pressure drop issues after reloading this material.

Visual Inspection of 140K lbs CoMo



Send to Reclaim

Visual Inspection of 250K lbs CoMo



Regenerated
95% RVA

WHAT IS SAS

Scandinavian Airlines?
The Society of Amateur Scientists?
Surfers Against Sewage?
No, no, and no!

SAS is EURECAT's unique Sample, Analyze, and Segregate service. With SAS, numerous samples of spent catalyst are carefully analyzed for contaminant metals, carbon and sulfur content, and surface area. From this data, a contamination profile (Fig. 1) can be developed. With this graphical profile, the process of segregating the material is straightforward.

Once the portion of the catalyst you want back is identified, an activity test can be performed on a composite sample in our multi-tube pilot unit at ULSD conditions. Pilot plant testing guarantees that the regenerated catalyst will give you the performance your units require.

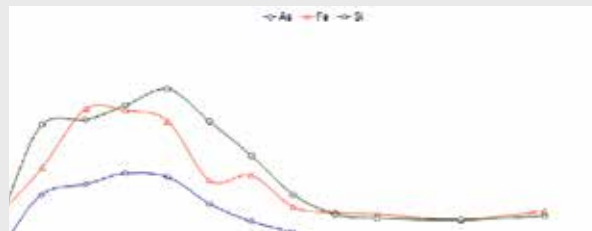


Fig. 1 — Arsenic, Iron, and Silicon Profile

GUARDIAN™ HIGH QUALITY BED GRADING PRODUCTS

TRILOBES ♦ RINGS ♦ INERTS



T5 PENTA-RINGS and CONVEX BEAMS

Guardian T5 and Convex Beams are inert ceramics with exceptional physical strength and maximum void space for reactor topping/hold-down and trapping of large particulates.



GUARDIAN CR and NR HOLLOW CYLINDERS

Active hollow cylinders are available in either CoMo (CR) or NiMo (NR) forms offering high void space more maximum particulate trapping effectiveness. Standard GUARDIAN CR and NR come into 1/8" (3mm), 3/16" (5mm), and 3/8" (9mm) sizes.



GUARDIAN CT and NT TRILOBES

Cost effective active 1/10" (2.5 mm) trilobes are available in either CoMo (CT) or NiMo (NT). These large extrudates combine excellent physical properties with moderate HDS and HDN activity.



1/16" (1.6 mm) and 1/20" (1.3 mm) RESALE CATALYSTS

EURECAT's activity-tested resale catalyst or third party fresh catalyst.



CERAMIC INERTS

Guardian Inert Ceramic Balls meet the tightest specifications for structural integrity and consistent density.

CUSTOM CATALYST TOLL MANUFACTURING

With our recent purchase of the Tricat Group, EURECAT is now uniquely qualified to develop and manufacture custom catalyst formulations. Our facilities in McAlester, Oklahoma include laboratories and pilot plants for producing small lots and proof-of-concept samples. We can also develop new custom catalyst formulations to match your application.

EURECAT manufactures and maintains multiple sources of common catalyst intermediates, allowing us to quickly respond to your needs. EURECAT's facilities in the USA and Europe have controlled atmosphere treatment capabilities such as reduction, selectivation, sulfiding, calcination, and several other catalyst conditioning processes.

OUR EXPERTS HAVE HUNDREDS OF YEARS IN THE FIELD OF CATALYST DEVELOPMENT AND PRODUCTION.

EURECAT's custom manufacturing capabilities include the following processes:

- » Jet Mill Grinding
- » Impregnation
- » Milling
- » Mulling
- » Extrusion
- » Reduction
- » Washing
- » Screening
- » Drying
- » Calcining
- » Sulfiding
- » Selectivation

ALLOW US TO PROVIDE YOU WITH A STRAIGHTFORWARD AND TRANSPARENT COST ANALYSIS FOR YOUR CUSTOM CATALYST PROJECT ALONG WITH ADVICE ON OPTIONS FOR CONTROLLING YOUR CATALYST COST.

EURECAT is the world's leading supplier of environmentally friendly catalyst services for refineries, gas processing facilities, petrochemical and chemical plants with a wide variety of environmentally friendly catalyst services:

- » Catalyst regeneration and rejuvenation, RAISE reactivation
- » Totsucat® sulfiding and activation of catalysts
- » Catalysts, Regenerated CoMo, NiMo and NiW for resale
- » Spent Catalyst Acquisition
- » Spent Catalyst Management
- » Reactor Management and CARBODUMP™

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