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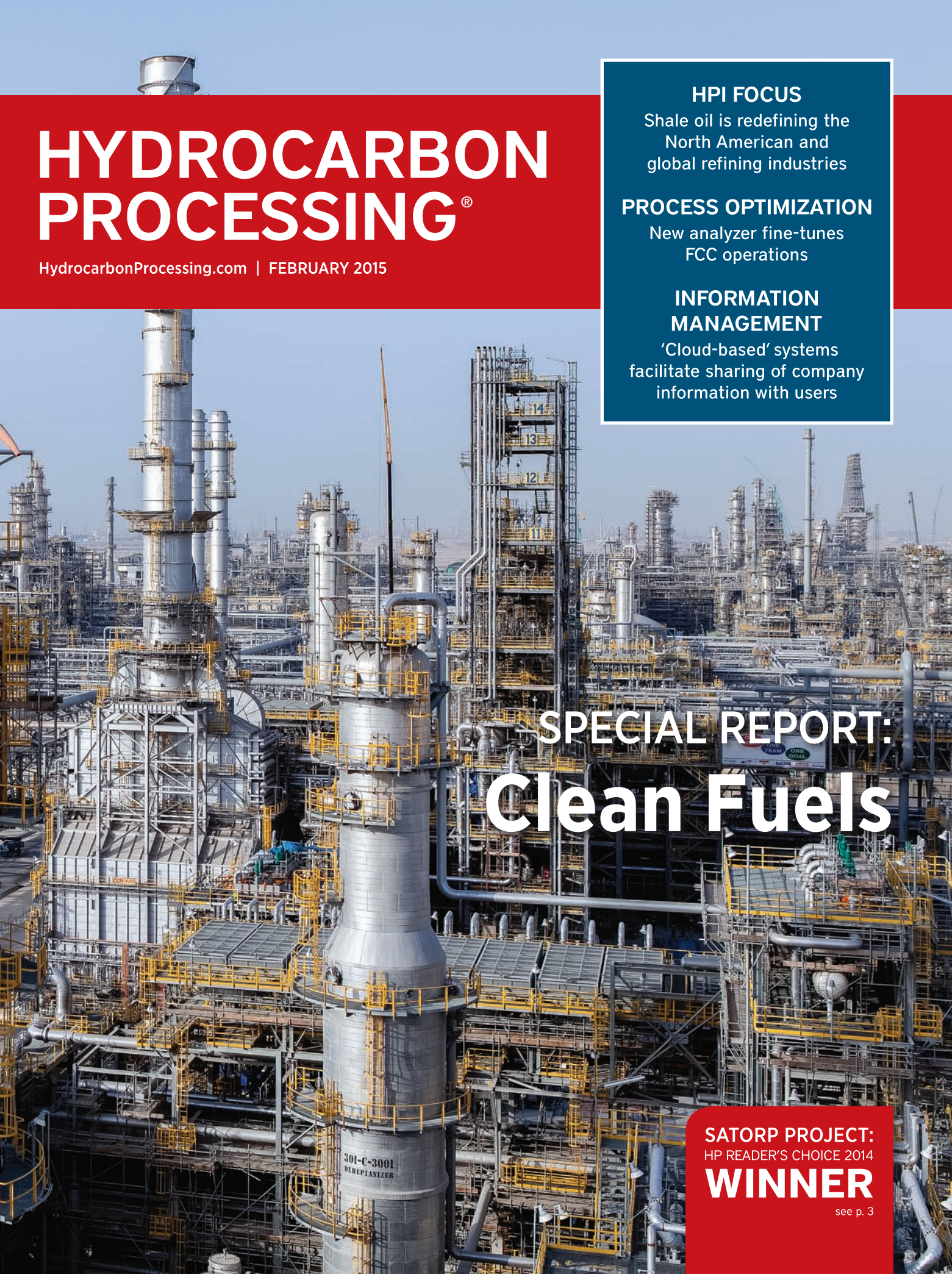

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Maximize precious metals returns from spent process catalysts

What you think you know, what you do not know, and what you should know about precious metal recovery of spent catalysts can impact your refinery's profitability. Most hydrocarbon, petrochemical and chemical processors operate precious metals asset recovery departments in one form or another. These are typically managed as independent profit centers. Due to global economic uncertainties, management of precious metals/spent catalysts has assumed a more important role in the past few years.

Business of refining metals. Selecting the right organization to recover and refine precious metals from spent process catalysts can make a significant difference in return values, thus enhancing corporate profitability. While this technology is viewed as a science, there are many misconceptions about how precious metals refiners work with customers, such as how they extract precious metals from spent process catalyst lots and how they provide return values to their customers.

Some organizations perceive precious metals refiners as merely "job shops." They move from one refiner to another at random between changeouts without much sense of "customer-vendor" loyalty. This may not be the best approach. There are precious metals catalyst users who do not know fact from fiction about this industry. There are really no "official" or sanctioned standards for reference. This article will provide some insight into the workings of the industry, hopefully will provide the catalyst owner solid technical, practical and productive knowledge to help enhance profitability and peace of mind when selecting and working with a precious metals refiner.

Precious metals in process catalysts. Typically, precious metals used in hydrocarbon and petrochemical processes include platinum (Pt), palladium (Pd), ruthenium (Ru) and rhodium (Rh); these are usually referred to as PGMs. Rhenium (Re), while not considered a PGM, is often present in precious-metal-bearing catalysts, and is a valuable metal. When it is time to recover these metals, the first thing to know is that all precious metals refiners are not the same. In fact, there are significant differences among the possible refining methods. Some differences can result in added costs (transportation/shipping, settlement delays, metals leasing and fees), less Re values returned, and even liability for environmental violations. The differences among refining organizations are primarily in the area of how they recover and refine PGMs, Re or other precious metals from spent process catalysts.

Essentially, there are two different refining technologies used for this purpose: *pyrometallurgical and hydrometallurgical.* This is important because there is a clear distinction between these technologies that will affect the outcome with regard to capturing the highest possible amounts of remaining precious metals in a spent catalyst lot—including Re (now valued at about $3,000/kg).

Sampling and assaying. Fundamentally, the recovery/refining process begins with complex, sophisticated sampling and analysis techniques to determine what metals, and their quantities, are present in a spent catalyst lot. Such catalyst lots may weigh 500,000 pounds and contain millions of dollars' worth of precious metals. Simply put, sampling is a series of processes used to create a homogeneous mass from spent catalyst lots, which are randomly "sampled" to determine the type, and the percentage, of precious metals still remaining in the entire lot.

Assaying the samples ultimately enables the precious metals refiner and the catalyst owner to agree on the value of the recoverable precious metals contained in the spent catalyst lot. Once this is done, the actual refining begins. Much information has been disseminated on these subjects over the years, and it is available from the web and previously published articles, among other sources. Therefore, we will consider sampling and assaying outside the scope of this article.

Added value from Re recovery. Because Re is both valuable and present in many spent process catalysts, owners should be aware that while all precious metals refiners are capable of recovering *most* of the Re content from spent process catalysts on soluble alumina carriers, until recently none has been able to recover virtually *all* of the Re content. The main reason for this is the inability to separate the remaining Re with a practical process for recovery and subsequent refining. Most precious metals refiners recover Re by dissolving their carriers (typically gamma aluminum oxide) with strong caustic or acidic chemicals (the hydrometallurgical or "digesting" process).

While this process is capable of recovering the soluble PGMs and Re content in spent catalysts, an unknown portion of the desirable "pay metals," sometimes as much as 20%, may remain behind due to the insolubility of their substrates or carriers. That insolubility occurs because the substrate may change phase as a result of overheating during years of operation, preventing their dissolution, even with

strong solvents (FIG. 1). Therefore, a refiner that uses pyrometallurgical technology can recover virtually *all* of the Re content from spent catalyst lots (semi-regenerative and cyclic-fixed bed), particularly from catalysts on substrates that cannot be dissolved with caustic chemicals. This process also offers significant advantages for maximizing return value of all remaining precious metals in the lot (FIG. 2).

Selecting the right organization to recover and refine precious metals from spent process catalysts can make a significant difference in return values, thus enhancing corporate profitability.

Not all precious metals refiners are the same. Remember the phrases, "Cheapness is false economy," and "You get what you pay for." It is no different in the metals refining industry. There is more than one type of precious metals refiner, and to serve your organization well, you must know the differences. There are full-service refiners—those organizations that provide complete in-house recovery and refining capabilities, including logistics to eliminate transportation/shipping charges and delays for settlement returns. There are "samplers/processors;" these organizations will partially process catalyst materials, perhaps upgrading them somewhat and combining smaller lots into larger lots. There are brokers—companies or individuals who simply buy and sell refining services and use offsite, third-party refiners.

The decision of which refiner to work with should be obvious when you consider the bottom-line transaction. For example, if a refiner promises 99.99% return of remaining precious metals value, then it is prudent to question exactly how that can be done. In other words, ask the refiner, "99.99% of what?"

Do your homework. If you consider quotes of a few pennies per pound difference for recovery and refining services when significant amounts of money are involved, you may want to look deeper into the refiner's business practices and capabilities. While refiners understandably want to cut costs whenever possible (just like any other business), this strategy has little to do with real money involved—the actual return value of precious metals in your spent catalysts.

On the contrary, it simply proves that cheapness is false economy since there may be tens of thousands of dollars in precious metals value that the catalyst owner may never receive. Again, do your homework and look into a "full-service" refiner, beginning with storage and shipping arrangements and continuing through in-house sampling and assaying—with an open line for the catalyst owner or its representative to be present at any stage of the process.

How much—and what kinds—of precious metals did you have? Here is a practical example to consider: When your spent catalyst lot is ready for recovery and refining, do you know how many ounces, and what kinds, of precious metals it contains? Certainly, you have accurate documentation from when the catalysts were purchased. However there are many circumstances here that can affect the "bottom line" return of precious metal values. For example, the variability (contents) of precious metals loading when the catalyst was manufactured. Each catalyst bead is slightly different; thus, it is understandable that each drum of catalyst is also slightly different. It is possible that a drum filled with precious metal-bearing catalyst contains slightly less precious metals content than contracted. Conversely, the drums may contain *more* precious metals than was contracted. Both examples have occurred.

Water and other contaminants in spent catalysts. Another critical factor is the amount of water contained by the catalyst prior to a processing campaign, which typically lasts for a number of years. The average water content may be listed on the certificate when the catalyst was purchased, but there is no way for the catalyst owner to determine the present water content after the catalyst's life cycle. The differences here can be significant.

In addition to water, there are other elements that accrue during processing, such as coke, carbon, sulfur and, perhaps, additives that may have been used to extend the life cycles. All of these elements have an impact with regard to the final recovery at the precious metals refiner. However, referring to the two different recovery and refining technologies previously mentioned, these factors become

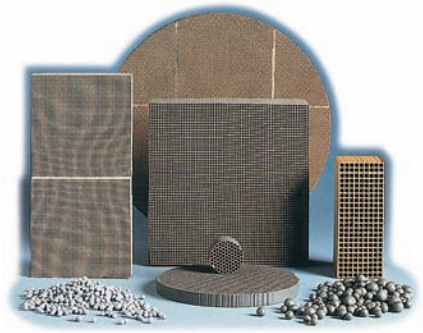

FIG. 1. Precious metal-bearing catalysts are typically formulated as pellets, beads and monolithic structures.

FIG. 2. Electric arc furnaces speed pyrometallurgical processing throughput to assure maximum recovery of remaining PGMs—and rhenium—in spent catalysts.

FIG. 3. The baghouse eliminates air pollution and captures precious metal particulates before discharge to atmosphere to ensure environmental law compliance.

more critical since they can interfere with the "digesting" process and its ability to capture all of the lot's remaining precious metals, including the Re content. This must be clearly understood by the catalyst owner with regard to which technique, pyrometallurgical or hydrometallurgical, is used.

You do not get your own precious metals back. Next, you should be aware that your refinery will not return the original precious metals that were in your spent catalyst lot. Individual customers' lots are typically not processed separately in this industry. Once sampling and assaying are completed (and remaining values are agreed upon), the catalyst owner receives new replacement metals, cash or vouchers for new metals from a common pool account. It is no different than withdrawing money from a bank; you will receive the equivalent value in new metals or cash.

Environmental standards. From a legal perspective and for your ultimate protection, you must also consider a refiner's procedures concerning its environmental management policies and adherence to other rules relevant to its processing methods and business practices. Responsibly recovering and refining precious metals requires that a refiner use rigidly controlled processes that comply with applicable environmental regulatory agencies. There are virtually hundreds of them throughout the world that concern effluent disposal and atmospheric emissions (FIG. 3). A properly equipped refiner will have the technology appropriate to comply with all international requirements, along with approved status from appropriate governing environmental agencies. For example, does the refiner have an anti-money-laundering (AML) policy as required by Sarbanes-Oxley and the U.S.A. Patriot Act? Does the refiner adhere to appropriate importing/exporting/transporting standards with regard to moving hazardous materials between states or countries? These subjects must be discussed openly. If you do not do your homework here, then your organization may be held liable for a refiner's violations.

Final thoughts. The key to selecting and working with a precious metals refining organization hinges on due diligence on your part with regard to understanding all of its policies and procedures, from contracts through completion. Of course, it is not rocket science, but overlooking critical details at the start may lead to undervalued returns at the end, since you are essentially establishing a mutually rewarding "partnership" with your refiner. HP

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