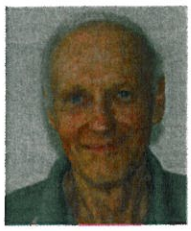
ask Bob

Bob McIlvaine



Special metals in air pollution control

Various terms are used to describe the metals and alloys involved in air pollution control. The term *heavy metals* includes a group of elements located in the periodic table between copper and mercury. This term is used in conjunction with air pollution regulations limiting metals emissions. *Precious metal* are rare, naturally occurring metallic chemical elements of high economic value. Platinum, which is used in air pollution catalysts, is one example.

The term *special metals* can also be used to describe alloys that offer unique and useful characteristics such as corrosion and wear resistance, strength, and workability.

There is no better place to start a discussion of metals in air pollution control than with the largest supplier and one of the largest users.

ArcelorMittal

ArcelorMittal is the world's largest steel company, with operations in more than 60 countries. In 2010, ArcelorMittal had revenues of $78 billion and crude steel production of 90.6 million tons, representing approximately 8 percent of the world's steel output.

The group is also one of the largest producers of iron ore worldwide, with mining activities in Algeria, Bosnia, Canada, Kazakhstan, Mexico, Ukraine, and the United States. In 2007, approximately 46 percent of the group's iron ore requirements and 13 percent of its coal requirements were supplied from its own mines or via long-term contracts.

Last month, the company announced the $2 billion expansion of its Mont-Wright mining complex and additional construction at Port-Cartier. The investment will allow ArcelorMittal Mines Canada to increase its annual production of iron ore concentrate from 14 million tons to 24 million tons by 2013.

The company's use of special metals for air pollution control purposes is extensive. Iron ore operations include scrubbers for pellet furnaces, which require corrosion- resistant materials. The company operates steel mills with furnaces, coke ovens, and sinter plants, which also require dust collectors constructed of alloy metals.

ArcelorMittal's Industeel division specializes in the supply of plates and clad plates for air pollution control applications. An important segment has been the supply of materials for stacks, ducts, wet electrostatic precipitators, and scrubbers for refineries, power plants, and chemical plants.

Duplex stainless steel

Over the past 15 years, the use of duplex stainless steels has increased extensively in many air pollution control applications. This is the result of continuous improvements in their composition and properties. Higher nitrogen contents have increased the duplex stainless steels' structural stability at high temperatures and consequently, their weldability. The cost advantage of duplex stainless steels over austenitics (which contain more nickel and molybdenum) has become more and more evident during the last four years, with the continuous price increase of alloying elements. Duplex and superduplex grades became increasingly attractive compared to 317LMN and 6 Mo in many applications.

In the October issue of *Air Pollution Control*, we will examine the use of specialty metals in wet electrostatic precipitators based on an ongoing survey and discussion conducted by Industeel with assistance by The McIlvaine Company.

Johnson Matthey

We now turn to an example of a company that uses precious metals to reduce gaseous pollutants. Johnson Matthey is a specialty chemicals company focused on catalysis, precious metals, fine chemicals, and process technologies. Principal activities are the manufacture of autocatalysts, heavy-duty diesel catalysts and pollution control systems, catalysts and components for fuel cells, catalysts and technologies for chemical processes, fine chemicals, chemical catalysts and active pharmaceutical ingredients; and the marketing, refining, and fabrication of precious metals.

Johnson Matthey has operations in more than 30 countries and employs about 9,000 people. The group is organized into three global divisions: Environmental Technologies, Precious Metal Products, and Fine Chemicals.

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Environmental Technologies includes several divisions focusing on the environmental compliance needs of a wide customer base. For example, Stationary Emissions Control is focused on the development, sale, manufacture, and service of catalysts for the control of nitrogen oxide (NO_x) emissions from coal-, oil-, or gas-fired power plants, waste-to-energy plants, industrial processes, and engines. One of Johnson Matthey's products is plate catalyst, often used in high-dust applications.

SINOx plate catalysts

The company's SINOx plate catalysts consist of catalytically active material composed of titanium dioxide, vanadium oxides, and tungsten or molybdenum oxides rolled onto stainless steel mesh. The catalyst plates are integrated into element frames that are installed in a steel module.

The typical application for SINOx plate catalysts is the abatement of NO_x under high-dust conditions. Examples are plants firing coal, heavy fuel oil and residual oil from refineries as well as industrial high-dust processes and wood- fired boilers.

The typical application for SINOx honeycomb catalysts is the abatement of NO_x under low-dust conditions. Examples are boilers firing gas and oil as well as gas turbines and internal combustion engines firing HFO, LFO, or gas. Exhaust gas from municipal waste incineration plants is another field of application. Tail-end and low-dust configurations often employ honeycomb catalysts.

Johnson Matthey also designs and supplies catalysts and engineers catalytic systems to control emissions of NO_x, carbon monoxide (CO), hydrocarbons (HC), volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and particulate matter (PM) from stationary gas and diesel engines, gas turbines, or other process applications (Fig. 1).

In addition to utilizing large quantities of precious metals, Johnson Matthey believes it is important that the platinum content of catalysts is recovered and reused, not only for the financial cost, but also for the environment.

With more than 192 years of experience, Johnson Matthey is the largest global full-service secondary refiner of platinum in the world. So as in the case of ArcelorMittal, Johnson Matthey is not only a supplier to the air pollution industry but an operator of air pollution control systems.

Anguil Environmental

Now let's turn to a company that tackles tough corrosion and temperature problems by utilizing its extensive knowledge of metal performance. Anguil Environmental Systems, Inc. is an air pollution control and energy recovery system provider headquartered in Milwaukee, WI, with offices in the United Kingdom, Asia, and an extensive network of agents located domestically and throughout the world.

Over the past 30 years, Anguil Environmental has developed a breadth of abatement technologies that control harmful and regulated VOCs, HAPs, process odors, and NO_x. The result is more than 1,700 installations around the world encompassing a wide range of applications and technology solutions.

The materials of construction for oxidizers are often upgraded from carbon steel to avoid corrosive environments where equipment life could be jeopardized. During the oxidation process, any halogenated compounds (chlorides or bromides) that exist in an airstream will convert to acid gases such as (HCl) or hydrogen bromide (HBr). To combat corrosion, certain components—or in some cases the entire oxidizer—are upgraded to high nickel alloys such as Hastelloy C-276. The other way to provide corrosion protection is to ensure that any HCl or HBr produced during combustion is never allowed to reach temperatures below the acid gas dewpoint. However,

Figure 1

Johnson Matthey extruded SCR catalyst.

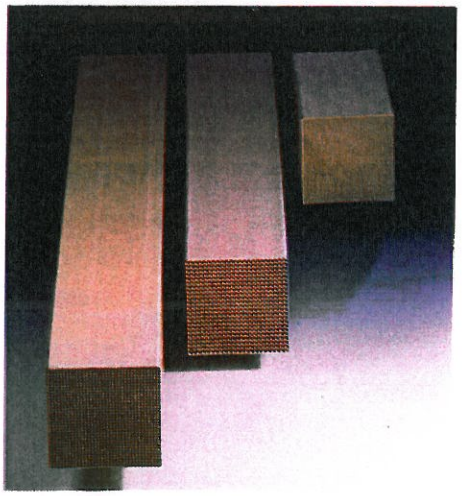

Figure 2

This Anguil RTO was manufactured with a stainless steel shroud and high nickel components to prevent corrosion.

even in these instances, a nickel alloy like AL6XN is recommended for components in contact with the process stream.

When encountering products of sulfur oxidation, Anguil uses either an alloy 20 material or they preheat them above the acid gas dewpoint and before using a 316 stainless steel material. In cases when there is a combination of both halogenated compounds and sulfur, a nickel alloy such as AL6XN is used to resist corrosion (Fig. 2).

Regardless of the oxidizer type and construction, when acid gases are present, Anguil oxidizers are kept under negative pressure within the equipment. With this arrangement, there is no chance for acid gases to escape and corrode components outside the equipment, which could result in premature failure.

Specialty metals play a major role in the world's air pollution industry. The generation of heavy metals by producers creates a market for air pollution control equipment. Precious metals play a big role in reducing and oxidizing noxious gases. Suppliers of air pollution control systems rely on metals producers for materials to withstand a wide range of temperature, corrosion, and mechanical stress conditions. **APC**

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The author will answer your questions in future columns. Direct questions to him at The McIlvaine Company, 191 Waukegan Road, Suite 208, Northfield, IL 60093, 847-784-0012 (rmcilvaine@mcilvainecompany.com), or to Editor, Air Pollution Control, 1155 Northland Drive, St. Paul, MN 55120, fax 651-287-5650 (cdanielson@cscpub.com).