



### ***RA2205 (UNS S31803/32205) Venturi Scrubber Unit for a Direct Reduced Iron (DRI) Facility Fabricated by Douglas Brothers***

Kvaerner Metals recently specified 2205 duplex stainless steel for several pieces of equipment to be used in a direct reduced iron (DRI) production facility. RA 2205 was used for two venturi scrubber units as well as two separation units. The design of the equipment was performed by Bionomic Industries of Mahwah, NJ. Douglas Brothers Inc. of Portland, ME was selected to fabricate the units.

The units were shipped to a new plant under construction to produce DRI briquettes, which are used as a feedstock in steel making. DRI is produced from reacting iron ore with a reducing gas generated from steam reformed natural gas. The reducing gas consists primarily of hydrogen, carbon monoxide, and carbon dioxide. The end product is a pellet or briquette containing 93% Iron and from 1-4% carbon. The DRI is then used as the feedstock for electric arc furnaces at steel mills.

RA2205 was selected for its resistance to general corrosion and chloride stress corrosion cracking. Concerns that the CO<sub>2</sub> in the waste gas might condense to form carbonic acid necessitated the use of a stainless steel for general corrosion resistance. Fresh water was going to be used as the cooling medium in the process. It was determined that the water supply contained up to 600 ppm chlorides. The presence of chlorides and the possibility of them concentrating combined with temperatures in the 210-230°F range ruled out the usage of conventional stainlesses such as 304L or 316L. These grades are susceptible to chloride stress corrosion cracking (SCC) under such conditions. RA2205 is a duplex stainless steel and therefore possesses excellent resistance to SCC.

Each venturi scrubber had a 42 inch ID and was fabricated from 1/2" RA2205 plate material.



*RA2205 separation unit being prepared for transport.*

Both scrubbers measured 7 feet in length. The separating towers were 9 feet in diameter and measured 45 feet in length. The towers utilized  $\frac{3}{8}$ " RA2205 plate material.

Joining of the RA2205 was done using both the Gas Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW) processes with RA2209 filler wire. GTAW welds were made with  $\frac{1}{16}$ ,  $\frac{1}{8}$ , and  $\frac{3}{32}$ " diameter wire. GMAW welds were made using 0.045" wire supplied in 30 lb. spools. RA2209 (ER2209) wire has a nominal composition of 22.5% Chromium, 8.0% Nickel, 3.0% Molybdenum, 0.14% Nitrogen. The nickel content is higher than that of the RA2205 base metal in order to ensure a proper

balance of ferrite and austenite in the weld bead. It is imperative that the completed welds in RA2205 possess the proper percentages of ferrite and austenite to ensure ductility and corrosion resistance matching that of the base metal. For this reason, all welds were also checked at 1 inch intervals with a Fischer Feritscope® to confirm proper ferrite levels were attained in the welds and the adjacent heat affected zone.

Over 20,000 pounds of RA2205 plate, piping and welding materials were supplied by Rolled Alloys, specialists in heat resistant, corrosion resistant, and aerospace alloys to complete the project.

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