AL-6XN® Alloy Resisted Corrosive Environments at Indianapolis Power and Light for over 5 Years

Specifications

UNS: N08367 **ASTM:** B 688, A 240, B 675, A 312, B 676, A 249, B 804, B 691, A 479, B 462, A 182, B 564, B 366, B 472
ASME: SB-688, SA-240, SB-6 75, SA-312, SB-276, SA-249, SB-691, SA-479, SB-462, SA-182, SB-564, SB-366 Code Case N-438-3, B-31.1 Case 155-1

Chemical Composition, %

	Ni	Cr	Mo	Mn	Cu	Si	C	N	S	P	Fe
MIN	23.5	20.0	6.0	–	–	–	–	0.18	–	–	–
MAX	25.5	22.0	7.0	2.0	0.75	1.0	0.03	0.25	0.03	0.04	balance

Case History

When an electric power plant burns coal to produce electric power, the product of combustion is known as “flue gas”. In many cases, that gas can be very corrosive to steel and even to stainless steels.

The corrosiveness of the flue gas is significantly increased when the coal is high in sulfur and/or chlorides. High sulfur and chlorides are typical of many of the fuels being used today. The ductwork which carries the flue gas from the boiler to the exhaust stack is one of the prime targets for corrosion. The duct is more vulnerable to corrosive attack if the flue gas cools to below its dew point and condenses to form sulfurous, sulfuric, and hydrochloric acid.

In the late 1980s, Indianapolis Power & Light Company (IP&L) was experiencing severe corrosion in random locations along the bottom and side walls in one of their steel rectangular ducts. This perpendicular duct carried flue gas at 260°F over 150 feet from the exit of an electrostatic precipitator to the intake of an induced draft fan which propelled the flue gas up the exhaust stack.

After investigating this problem, IP&L engineers found that the flue gas was condensing when coming into contact with cold spots. Duct corners between the wall and the floor, which were externally supported by steel braces, tended to be at temperatures below the dew point of the gas. It is in this area that condensate was formed. The condensate was mostly a combination of sulfuric acid (H_2SO_4) and chlorides (Cl). IP&L engineers have calculated that this gas carries approximately 33 lbs./hr. of Cl and 29 lbs./hr. of H_2SO_4.

Case History, Continued

IP&L engineers contacted Rolled Alloys®, inquiring about 904L and 317L, and learned about the suitability of AL-6XN alloy in this high chloride, reducing acid environment. They then researched the AL-6XN alloy and selected it to be used as a liner for the floor and part of the side walls of their 12' wide by 24' high duct.

AL-6XN alloy was selected for this direct flue gas duct because of its excellent resistance to chloride pitting and acid corrosion. Rolled Alloys supplied the 35,000 pounds of 4' x 12' x 14ga. AL-6XN alloy sheet for lining the carbon steel duct. Sterling Boiler, Evansville, IN was selected as the fabricator to make the installation.

The AL-6XN alloy sheets were installed by use of a wallpapering method. They were fitted into place by allowing for 90° bends at the floor to wall interface and by overlapping every sheet. The alloy sheets were plug welded to the carbon steel on 2' centers and then were overlaid with a diamond patch of AL-6XN sheet. All overlaps were seal welded by use of GMAW welding with 625 filler wire. The interface between the AL-6XN alloy and the wall was also seal welded with 625.

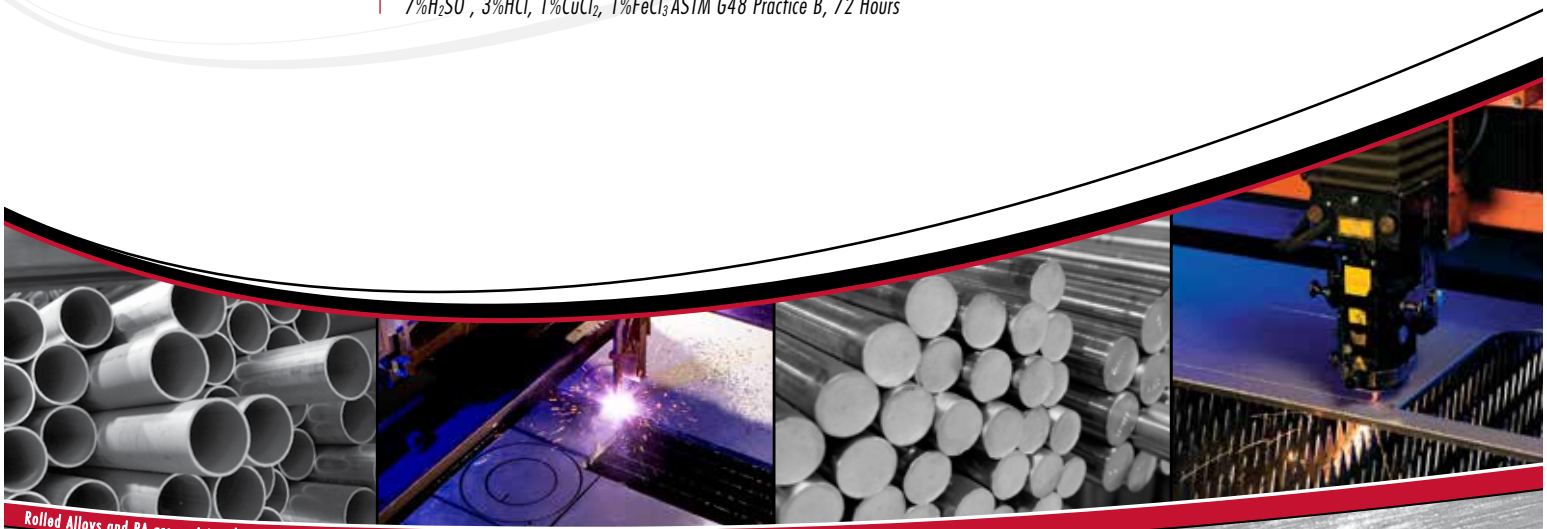
Five years after the installation was performed, a new scrubber was constructed and the duct was removed. The AL-6XN liner appeared to be in good condition. In some areas, the original line marking on the material was still present.

Because of the success IP&L had with AL-6XN alloy, they selected the alloy for part of the absorber tower in the No. 3 scrubber unit at the same plant. AL-6XN was installed in the areas contacted after the quench section. After 5 years, the AL-6XN alloy was reported to be in good condition and remains in service.

This 20.5% chromium, 24% nickel, 6.2% molybdenum alloy is nitrogen enriched for strength and offers the highest resistance to localized corrosion i.e., pitting, crevice corrosion, and under-deposit corrosion when compared to other stainless steels. AL-6XN offers a significant degree of protection to acid corrosion as well.

Alloy	Weight Loss, g/cm², 75°F	Weight Loss, g/cm², 112°F	Weight Loss, g/cm², 158°F
316 L	0.0006	0.0343	0.0390
317L	0.0007	0.0377	0.0500
317LMN	0.0000	0.0129	0.0462
904L	0.0000	0.0221	0.0419
AL-6XN	0.0000	0.0000	0.0266
625	0.0000	0.0000	0.0149
C-276 [4]	0.0000	0.0000	0.0004

7%H_2SO , 3%HCl, 1%$CuCl_2$, 1%$FeCl_3$ ASTM G48 Practice B, 72 Hours



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