Hastelloy C-22 Alloy

Heanjia Super Metals Co., Ltd

Hastelloy C-22 is a flexible alloy comprising of nickel, chromium, molybdenum and tungsten as the prime elements. It offers the higher resistance than the Nickel-Chromium-Molybdenum alloy. The **Hastelloy C-22 alloy** offers exceptionally high resistance to pitting, crevice corrosion and stress corrosion cracking. It offers superior resistance to oxidizing aqueous conditions as well as hydrates chlorine and nitric acid and other oxidizing acids and chlorine ions.

The material of C-22 wire is analyzed to measure the resistance to corrosion offered by the material. The alloy comes in the category of UNS number N06022 though with the limited composition to provide an enhanced functionality. The improvements are very important that the wire is highly patented in the whole world.

Chemical composition of Hastelloy C-22 Alloy

Ni	Co	Cr	Mo	W	Fe	Si	Mn	C	V
56	2.5	22	13	3	3	0.08	0.50	0.010	0.35

Corrosion resistance

The alloy offers superior resistance to reducing and oxidizing media offered in the process streams. Due to its large flexibility it can be subjected in the severe conditions that normally occur in the multifunctional plants. The alloy offers intense resistance to the various chemical processing conditions such as strong oxidizers like ferric and cupric chloride, hot solutions containing organic and inorganic acids, formic and acetic acids, acetic anhydride.

The high resistance C-22 alloy also resists the production of grain precipitates in the welded areas so it is best fit for using in the chemical processing in the welded applications.

Physical properties of Hastelloy C-22 Alloy

Density	75oF	0.314 lb/in.3	24oC	8.69 g/cm.3
Melting Range	2475-2550oF		1357-1399	
Thermal Conductivity	118oF	70 Btu-in./ft.2 hr.-°F	48oC	10.1 W/m-K
Specific Heat	126oF	0.099 Btu/lb.-°F	52oC	414 J/Kg-K

Electrical and thermal properties of Hastelloy C-22 Alloy

Temp., oF	Temp., oC	Electrical Resistivity microhm-in.	Mean Coeffi of thermal expansion, microinches/in.-°F
75	24	44.8	6.9
212	100	48.3	6.9

392	200	48.7	7.0
572	300	49.3	7.4
752	400	49.6	7.7
932	500	49.9	8.1
1112	600	50.2	8.5

Dynamic Modulus of Elasticity

Form	Condition	Temperature		Modulus of elasticity	
	Heat-treated at 2050°F or (1121°C) quick Quenched	oF	oC	10-6 psi	GPa
Plate		200	93	29.4	
		400	204	29.4	203
		600	316	28.5	196
		800	427	27.6	190
		1000	538	26.6	183
		1200	649	25.7	177

Corrosion protection in the chemical processing house

Reactor Vessel 10-15% Sulfuric Acid + Solids /Impurities 212°F (100°C) — 12 Months	Alloy	Corrosion rate (mpy)	Output
	316L Stainless Steel	>61	Sample Dissolved
	Carpenter 20Cb-3® alloy	>57	Sample Dissolved
	Alloy 825	>58	Sample Dissolved
	HASTELLOY® B-2 alloy	>58	Sample Dissolved
	HAYNES® 625 alloy	29	Severe Corrosion Attack
	HASTELLOY C-276 alloy	28	Severe Corrosion Attack
	HASTELLOY C-22® alloy	4.7	Severe Corrosion Attack

Average tensile properties of Hastelloy C-22 Alloy

Form	Temp, oF	Tensile Strength, ksi	Yield Strength, ksi	Elongation, %
Sheet, 0.028 - 0.125 in (0.71 - 3.2 mm) thick**	200	110	54	58
	400	102	44	57
Plate, 1/4 - 3/4 in. (6.4 - 19.1 mm)	200	107	49	65
	400	98	41	66
Bar, 1/2 - 2 in (12.7 - 50.8 mm diameter	200	105	45	73
	400	96	38	74

Rate of corrosion in Flue Gas Desulfurization (FGD)

Pulverized Coal Fired Unit 4.8% Sulfur Outlet Duct 129°F (54°C) — 27 Months	Alloy	Pitting (in)	Crevice (in)
	316L Stainless Steel	0.011	0.015
	Alloy 904L	0.010	0.005
	Jessop JS700® alloy	0.010	0.011
	HAYNES 625 alloy	No Attack	0.005
	HASTELLOY C276 alloy	No Attack	0.007
	HASTELLOY C-22 alloy	No Attack	0.002

Rate of corrosion in Refinery Industry

Coke Refinery Vaporizer	Alloy	Corrosion Rate (mpy)	Output
	316L Stainless Steel	139	Severe Crevice Attack

203°F (95°C) — 2 Months	Carpenter 20Cb-3® alloy	227	Partially Dissolved
	Avesta 254 SMO® alloy	83	Pitting, Crevice Attack
	Allegheny AL-6XN® alloy	60	Pitting, Crevice Attack
	HAYNES 625 alloy	29	Pitting, Crevice Attack
	HASTELLOY C-22 alloy	3.4	Pitting, Crevice Attack

Corrosion-Resistant Weld Filler Metal

The welded alloys often suffer from corrosion. For reliable and economical solutions, Hastelloy C-22 filler metal is used. The following table shows the corrosion rate of different weld metals and base metals:

Medium	Base Metal	Filler Weld	Corrosion Rate (mpy)
3M NaCl+0.1M FeCl3+0.1M NaF 167°F (75°C), pH = 1	625	625	100
	625	Hastelloy C-22	94
	Hastelloy C-22	Hastelloy C-22	0.17

Thermal Stability

The weldments of alloy C-276 and C-22 are set into oxidizing sulfuric acid process solution.
The Hastelloy C-276 suffers from uncommon attack on the severe base metal, weld metal and heat affected area in this condition. It is found that only 1/3rd of heated alloy's thickness is corroded. The Hastelloy C-276 is rarely corroded in the other conditions.

The C-22 alloy is preferably chosen for its wider testing in the bleach water conditions. It has already provided prolonged performance of several years more than 10 without getting any corrosion. Apart of Hastelloy C-22 other 20 different samples were analyzed though all were failed. The C-22 alloy gives much more enhanced resistance to corrosion as compare to the original metal.

Fabrication of Hastelloy C – 22 Alloy

The wrought C-22 alloy is prepared in the heat processed solution until it is recommended. The alloy is heat processed at 2050oF temperature or 1121oC and quickly quenched. The components that are hot forged or intensely cold forged must be solution heat processed before fabrication.

Applications

The range of applications of **Hastelloy C-22 alloy** is discussed below:
Acetic Acid/Acetic Anhydride Acid Etching, Cellophane Manufacturing, Chlorination Systems, Complex Acid Mixtures, Electro-Galvanizing Rolls, Expansion Bellows, HF Furnace Scrubbers, Nuclear Fuel Reprocessing, Incineration Scrubber Systems and SO2 Cooling Towers and more.

The electrogalvanizing finish rolls made of Hastelloy C-22 alloy are utilized in the steel finish manufacturing. The alloy decreases the defects on rolls that is essential to produce defect free galvanized steel in the automotive industry.

The solid rocket propellant effluents and salt air causes pitting and crevice corrosion attack to the stainless steel. The **Hastelloy C-22 alloy** is selected over 19 different alloys due to extensive resistance to corrosion.
