Alloys used in Marine Offshore Oil and Gas Industry

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Due to the hostile conditions offshore oil and gas platforms operate under, combined with the acidity due to processing hydrocarbons, many alloys are used in the marine offshore oil and gas processing equipment and piping systems, enabling the equipment to work under high temperature and pressures.

Introduction to Alloys used in Marine Offshore Oil and Gas Industry

I worked for many years in the offshore oil and gas industry as a Project Mechanical Engineer, seeing firsthand the problems corrosion from the salt laden environment can generate. The offshore processing of hydrocarbons can also produce corrosion to the internals of the equipment and piping systems.

This is an article on the use of alloys in the offshore oil and gas industry. Here we examine the role of alloys and the new super-alloys both to combat corrosion and provide a material with properties suitable for use in high temperatures and pressures of oil and gas processing.

We begin with the elements used in alloying and the properties they bring to the alloy.

Elements and Metals used to Produce Alloys

- **Nickel**

Nickel is one of the most common elements combining easily with most metals and elements, creating an alloy resistant to acid and chemical corrosion, and promoting good thermal properties. When added to copper produces the alloy copper/nickel (cuni) and when alloyed with chrome produces different grades of stainless steel alloys.

Nickel is the main element in the production of superalloys such as incoloy and inconel that have very high resistance to erosion, corrosion, high temperatures, and pressures.

- **Chrome**

Added to produce an alloy, and increasing its hardness, resistant to corrosion, and erosion.

- **Copper**

Used to induce corrosion resistance, e.g. alloyed with zinc and tin to produce the alloy bronze, or with nickel to produce cuni.

- **Titanium**

A relatively new element can be used in its basic form due to its weight/strength ratio. It is added to an alloy to increase its strength and use at very high temperatures, as well as improving its corrosion resistance to chemicals and acids.

- **Molybdenum**

Used to give the alloy strength at high temperatures.

- **Zinc**

Zinc is added to aluminum and copper in various quite high percentages to improve the properties of hardness and creep of the respective alloys. It is also used in large quantities to galvanize thin steel sheets for use in HVAC duct fabrication and process pipes against corrosion. This treatment is known as "hot dipped galvanizing."

- **Silicon**

Silicon is added to deoxygenate the alloy.

Note:
Aluminum alloys are used offshore for many structural applications due to their strength and lightness, so they are worthy of a mention before we leave this section. They are produced using small percentages of most of the above elements, usually totaling about 0.5%, the other 99.5% being base aluminum.

Reference Web: megamex - elements used as alloys

Applications of Alloys used Offshore

Mild steel is still extensively used in the form of flat and rolled plate in the construction of offshore production platforms, steel jackets and drilling rigs along with piping systems that are subjected to rigorous grit blasting followed by anti-corrosion coatings. This is to combat the decks being sprayed by seawater and salt laden air produced by gale force winds. Most of the process equipment and piping however is manufactured from corrosion resistant, high temperature and pressure alloys as listed below.

Applications of Alloys used Offshore

1. Structural

- Aluminum Alloy: Used to fabricate platform helidecks and telescopic gangways between platforms and individual modules.
- Stainless Steel Alloy: used to line switch-rooms, generator rooms, accommodation, and galleys.

2. Mechanical Equipment

- Titanium and Stainless Steel Alloys: High pressure and temperature applications such as gas plate heat exchanger plates, internal fittings in gas and oil separators, export oil and gas pumps, process pumps and compressor impellors.

3. Piping

- Duplex Stainless Steel Alloy: fabrication of pipes from duplex gives high corrosion resistance to process and instrument piping.
- Stainless steel and copper/nickel (cuni) alloys used for manufacture of hydrocarbon piping.
- Copper/Nickel Alloy: cuni, the popular alloy for seawater cooling and firewater systems, also used as lining for stainless and mild steel pipe in hydrocarbon systems.
- Inconel: a nickel-based superalloy. Used for high temperature/pressure process systems, gas turbine blades, exhaust gas economizers, and high temperature gas plate heat exchanger plates.
- Inconel: as above, used to manufacture sour gas flare tips, associated support frames, and piping systems due to high temperature and non-oxidizing properties.

4. Electrical Equipment.

- Stainless Steel Alloys: used to manufacture panels for switchgear and junction boxes.

5. HVAC

- Stainless Steel Alloys: used in the manufacture of fire dampers and in-line fans in HVAC ducting systems, also large air handling units exposed to environment.

6. Fireproofing and Insulation

- Stainless Steel Alloy: firewalls, blastwalls and heat shields for gas flare.
- Stainless steel alloy cladding over insulation in gas, oil and firewater piping systems and associated vessels.

7. Structural Anticorrosion

- Aluminum Alloy Spray: this is used extensively on the steelwork of the splash zone; the steelwork between the top of the sea and the underside of the platform that is exposed to wetting from wind-borne salt and the continual splashing from waves.
- Stainless Steel Alloy Cladding: thin sheets are used to clad mild steel process vessels, especially those in vulnerable locations, i.e. close to platform extremities and in the path of prevailing wind.

Source:

http://www.brighthubengineering.com/marine-engines-machinery/82494-alloys-used-in-marine-offshore-oil-and-gas-industry/