Analysis of Maintenance Affecting Performance of Energy Efficiency of Heat Exchanger

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Abstract- The paper presents the main activities of maintenance that ensures the operating characteristics of the fluid used to transfer energy flows. Through their adequate treatment and maintain quality exchanger surfaces energy flows through periodic cleaning with or without disassembly.

Indexed Terms- heat exchanger, fouling, overall heat exchanger temperature,

I. INTRODUCTION

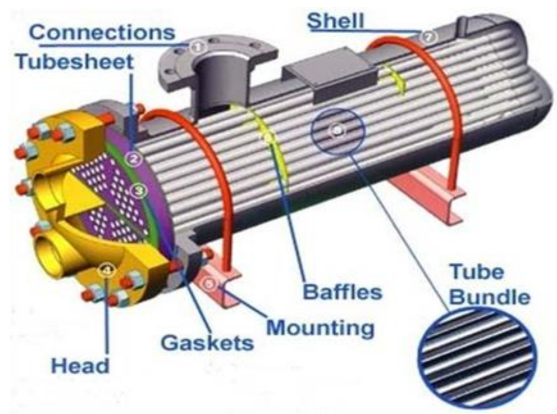
Flux exchangers of thermal energy are devices that allow the transfer of heat between two or more fluids having different temperatures. Flux exchangers of thermal energy have an important role in extraction of flux of thermal energy produced by a mechanism in operation to keep the temperature of the equipment. Also needed to enhance the ability of heat exchange, which is reduced after a period of operation without interfering with maintenance operations.

Marine energy systems, flux exchangers of thermal energy are found as steam generators, water heaters, preheaters and coolers (condensers) and evaporators used in installations for producing technical water from seawater. Flux exchangers of thermal energy can take place with or without changing their state of aggregation, which influences the design of the exchangers. Thus according to the state of aggregation of fluids in flux exchangers of thermal energy used in marine energy plants, this can be divided into:

- heat exchanger that performs heat exchange without changing the fluids state of aggregation like coolers and heaters;
- heat exchanger that performs heat exchange with changing the state of aggregation one of fluids or all like evaporators and condensers.

From the point of view of the geometrical configuration, the heat exchangers can be:

- tubular heat exchangers whose construction consists of a large diameter tube through which to be circulated the fluid to remove the heat, in which is inserted a number of pipes through which circulates the fluid gives off heat (*figure1*);



II. MAINTENANCE OF HEAT EXCHANGER SURFACES

After ensuring procurement, effective maintenance holds the key to optimizing power consumption.

Heat transfer can also be improved by ensuring proper separation of lubricating oil and the refrigerant, timely defrosting of coils, and increasing the velocity of secondary coolant (oil, air, water, etc).However, increased velocity results in larger pressure drops in distribution system and higher power consumption in pumps.

Fouled condenser tubes forces the compressor to work harder to attain the desire capacity. For example a 0.8 mm scale built up on condenser tubes can increase energy consumption by as much as 35 %. Similarly, fouled evaporators (due to residual lubricating oil or infiltration of air) result in increased in power consumption. Equally importance is proper selection, sizing, and maintenance of cooling towers. A reduction of 0.55 ˚c temperature in water retaining from cooling tower reduce compressor power consumption by 3%.

Effect of poor Maintenance on Compressor Power Consumption.

Condition	Evaporator Temp .(˚c)	Condenser Tem. (˚c)	Refrigeration Capacity (tons)	Specific power Consumption (KW/ton)	Increase in KW /ton (%)
Normal	7.2	40.4	17.2	0.68	-
Dirty condenser	7.3	46.13	15.5	0.83	20.10
Dirty evaporator	1.7	40.85	13.2	0.81	18.02
Dirty condenser and evaporator	1.8	46.5	12.5	0.97	38.6

Table No -1

III. MAINTANCE OF NAVAL HEAT EXCHANGER

The coolant used is providing from the environment where the system works. For naval heat exchangers the coolant used in most cases, it is seawater, but is also used technical water (freshwater), oil and air. Using seawater, being an inexhaustible source of cooling, corrosion and scale deposits are common effects that modify the functional parameters of marine heat exchangers. Maintenance of marine heat exchangers is therefore necessary at regular intervals of time to prevent reduction of heat transfer or failure of equipment. Depending on the type of heat exchangers and on the type of fouling, various maintenance methods are used as the final the heat transfer surfaces must be cleaned to prevent any blocking of the flow process.

Technical water quality (in most cases seawater) is essential for optimum performance and long serviceable life of heat exchangers. The chemical composition of water is very important for optimal heat exchange. For seawater the fouling effects of salt deposits are directly proportional to its salinity. The salinity of seawater globally has variations of dissolved solids in the liquid at 800 ppm (mg / l) in the Baltic Sea up to a maximum of 60,000 ppm in the Arabian Gulf, where due to water evaporation due to high temperature air desert area. The nominal composition is considered to 34,500 ppm water from which the 25,000 ppm sodium chloride. In Table 2 is shown the seawater composition.

Component	Concentration [mg/l]	Total Salt [%]
Chloride	18,980	55.04
Bromide	65	0.19
Sulfate	2,649	7.68
Bicarbonate	140	0.41
Fluoride	1	0.00
Boric acid	26	0.07
Magnesium	1,272	3.69
Calcium	400	1.16
Strontium	13	0.04
Potassium	280	1.10
Sodium	10,556	30.61
Total	34,482	99.99

Table 2– Composition of Seawater

of the water salinity definitions refer to the total mass in grams of inorganic salts of a kilogram of sea water when all the bromides and iodides are replaced with the equivalent chlorides and all oxides of carbon quivalents . Salinity is usua fouling, Crystallization fouling, consisting in deposits of calcium carbonate, calcium sulfate l measured by determining of the conductivity or of the chlorine content.

Fouling of naval heat exchangers is relatively a complex process that is to be taken into account at their design and use.

Fouling in heat exchangers by circulating seawater is of several types:

- Crystallization and other salts whose solubility decreases with increasing temperature. This phenomenon generates the deposition of salts on the surfaces of heat exchanger pipes;
- corrosion fouling, is caused by oxidation of the metal layers resulting in the deposition of oxides on the tubes of the heat exchangers;
- Biological fouling, produced by marine microorganism that grows inside the exchangers forming bacteria or algae deposits, such as mussels and leeches or macro. A special case occurs in the Black Sea water, which in hydrological point of view is a remnant of Sarmatian Sea, with a number of unique aspects in the world including the salinity with averages of 16 ÷ 18 grams of salt per liter instead of 34 ÷ 37 grams per liter in other seas and oceans. This salinity has allowed the development of a very rich microorganism fauna entering the heat exchangers and grows in an accelerated way compared with macro organisms in other seas and oceans, producing biological fouling.
- Particulate fouling that represents the content of sand, silt, mud or other fine particles.
- Most problems arise from corrosion fouling and from biological fouling.

Predominant factors in the occurrence of fouling are:

- Surface temperature, Chart in figure 5 is the evolution of coefficient corrosion Rf in function of temperature at constant speed of movement of water for each type of fouling.

CONCLUSION

Variety of sources that may cause fouling deposits on heat exchangers surfaces resulted in a very complex approach in terms of design, construction, operation and maintenance of these.

Since the deposition of fouling in heat exchangers impedes the flow of heat exchange, it requires careful planning of maintenance operations that will take into account the synergy of the chemical mechanical cleaning depending on the type of fouling.

REFRENCES

[1] Green Instrumentas, Denmark, G5000 Boiler Dynamic Multi-Parameter Monitoring-Monitoring, www.greeninstruments.com ;

[2] Pacific Marine & Industrial- Shell and Tube Heat Exchangers, http://www.pacificmarine.net/engineering/heat-exchangers/shell-and-tube-heat-exchangers.htm;

[3] Performance Of Tubular Alloy Heat Exchangers In Seawater Service In The Chemical Process Industries, Publish by Materials Tehnology Institute of the Chemical Proces Industries, Inc. and Nickel Development Institute, https://www.nickelinstitute.org/~/media/Files/TechnicalLiterature/PerformanceofTubularAlloyHeatExchangers inSeawaterServiceintheChemicalProcessIndustries_12002_.ashx;

[4] S. Pugh, G.F.Hewitt, H. Muller-Steinhangen"Fouling During the Use of Seawater as Coolant - The Development of a `User Guide' ", Engineering Conferences International Year 2003;