http://dx.doi.org/10.21172/ijiet.123.12

Performance Assessment of Water Soluble Polymer as Anti-Scaling Agent on Double Pipe Heat Exchanger

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Abstract- The polymer was synthesized using solution polymerization technique. The poly acrylic acid is formed by adding acrylic acid monomer and benzoyl peroxide as an initiator in the presence of suitable solvent.The reaction is carried out at 80oC temperature. The characterization of poly acrylic acid is observed by using Fourier Transfer Infrared Technologyand Scanning Electron Microscope. The synthesized polymeris used as additive to water in double pipe heat exchangeras anti-scaling agent for extended durations at varied temperatures on lab scale. Series of observations were noted for different concentrations of polymer and temperature to come across an optimum combination of the two. With the increase in concentration of the polymer scale deposition is reduced.
Key-words: poly-acrylic acid, initiator, anti scaling agent, double pipeheat exchanger

I. INTRODUCTION:

Scaling or fouling is major problem for heat transfer equipment in process industries. Scaling is occurred due to hardness and impurities present in water scaling. Fouling causes the damage of heat transfer equipment [12], it reduces the rate of heat transfer and it is responsible for corrosion of the heat transfer equipments. Due to scaling problem maintenance cost of heat transfer equipment is increased .To avoid scaling problem an effective anti scaling agent is required.Rajendran S.et. al.[3] have indicated that some polymers can be used as corrosion inhibitors because, through their functional groups, they form complexes with metal ions and on the metal surfaces.

Sedahmedet. al.[9] investigated the effective utilization of formulation containing Polyethylene Oxide, Polyacrylamide and Carboxymethyl cellulose (CMC) as an corrosion resistance for the metal iron in acidic and neutral medium using electrochemical methods and found that this formulation is found to act as an excellent inhibitor for controlling severe problem of corrosion and scaling arising during the processing operations.

Poly-acrylic Acid (PAA) is generic name for synthetic high molecular weighing polymers of acrylic acid. Poly-acrylic Acid is used as Anti-scaling agent in heat exchangers, in dental cement, as dispersing agent, adhesives and as surface coating agent, to increase the strength of concrete and as drug intoxicant.

Polymerization of acrylic acid carried out by solution polymerization[1]. The monomer is dissolved in a suitable inert solvent along with the chain transfer agent, if needed, to control molecular weight of polymer. The free radical initiator is also dissolved in the solvent medium. The presence of inert solvent medium helps to control rise in viscosity and promote a proper heat transfer. The polymer formed is isolated from the solution either by evaporation of the solvent or by precipitation, in a known solvent. The technique is useful if polymer is required to be used in the solution form such as an Anti-scaling agent. The characterization of poly acrylic acid is observed by using FTIR and

II. SEM TECHNOLOGY.

2.1 Experimental Investigations:

The poly acrylic acid is applied on doubleheat exchanger with constant flow of fluids.Dimension and details of the heat exchanger are as shown below:

Table1: Dimension and details of double pile heat exchanger

Parameter	Inner tube	Outer tube
Inside diameter (mm)	20.34	30.81
Outside diameter (mm)	21.02	40.30
Length of tube (mm)	1000	1000
Material of constriction of tube	Copper	Stainless Steel
Initial temperature 0C	40	27
Fluid water	Hot	Cold

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2.2 Observations:

Following observations were taken with multiple variables as mentioned in the respective tables for the investigation of effect of PAA as anti-scaling agent and its performance at varied temperature ranges.

Table 2: Runs Without PAA sample

Sr. No.	Temperature (0C)	Days	Hardness of water in ppm
RUN 1	40	1	200
RUN 2	45	30	198
RUN 3	50	60	196
RUN4	55	90	191
RUN5	60	120	187
RUN6	65	150	181

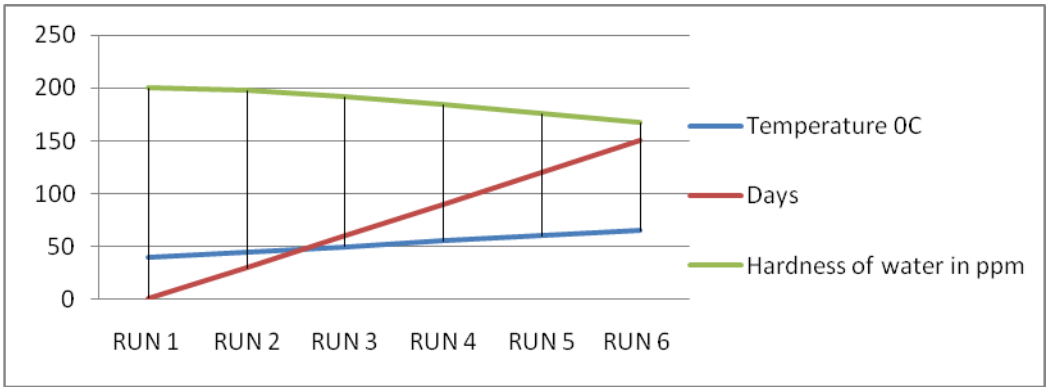

Figure1: Runs without PAA sample

Table 3:Water with PAA50 ppm

Sr. No.	Temperature (0C)	Days	Hardness of water in ppm
RUN 1	40	1	200
RUN 2	45	30	200
RUN 3	50	60	196.5
RUN 4	55	90	192
RUN 5	60	120	188
RUN 6	65	150	182

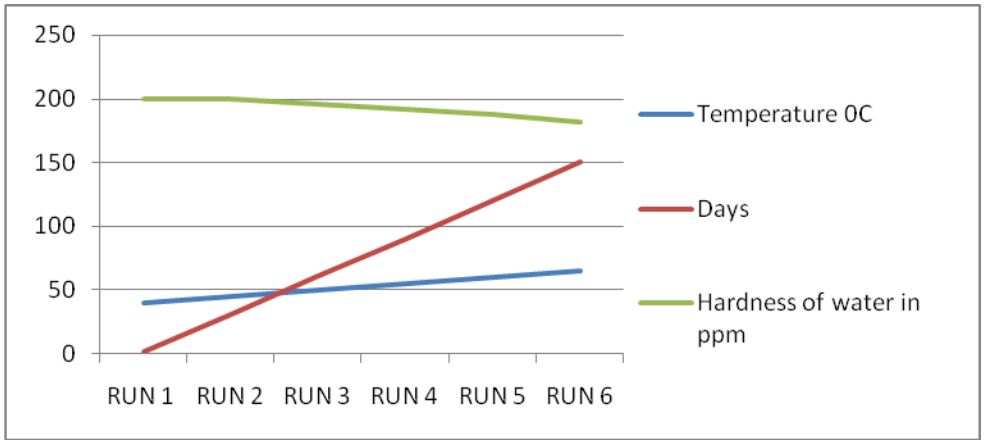

Figure 2: Runs with 50 ppm PAA sample

Table 4: Runs with PAA 100 ppm

Sr. No.	Temperature (0C)	Days	Hardness of water in ppm
RUN 1	40	1	200
RUN 2	45	30	200
RUN 3	50	60	198

RUN4	55	90	191
RUN5	60	120	189
RUN6	65	150	187

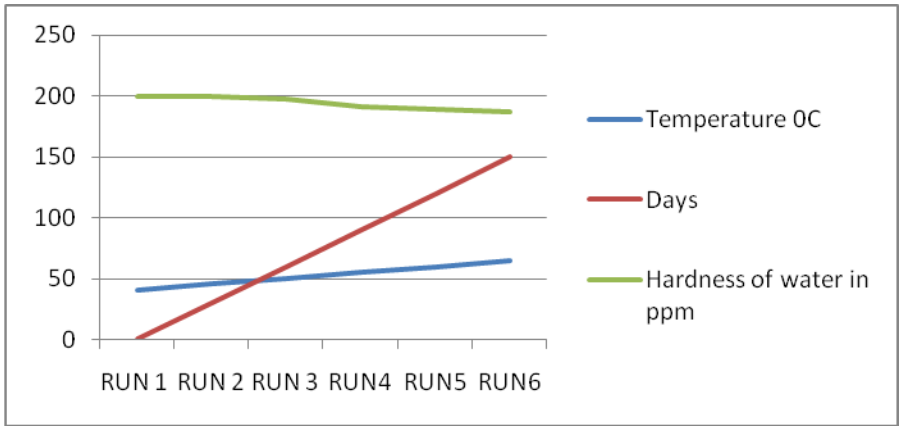

Figure 3: Runs with 100 ppm PAA sample

Table 5: Runs with PAA 150 ppm

Sr. No.	Temperature (0C)	Days	Hardness of water in ppm
RUN 1	40	01	200
RUN 2	45	30	200
RUN 3	50	60	200
RUN4	55	90	197
RUN5	60	120	192
RUN6	65	150	185

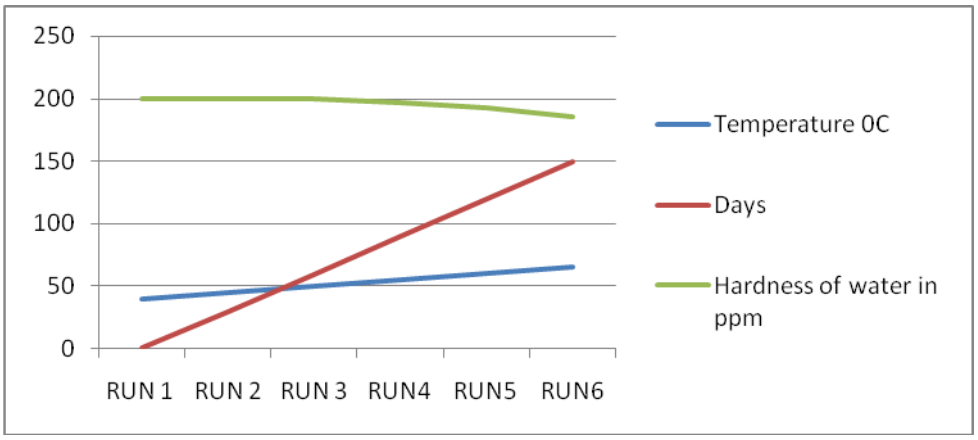

Figure4: Runs with 150 ppm PAA sample

Table 6: Runs with PAA 200 ppm

Sr. No.	Temperature (0C)	Days	Hardness of water in ppm
RUN 1	40	1	200
RUN 2	45	30	200
RUN 3	50	60	200
RUN 4	55	90	199
RUN 5	60	120	197
RUN 6	65	150	195

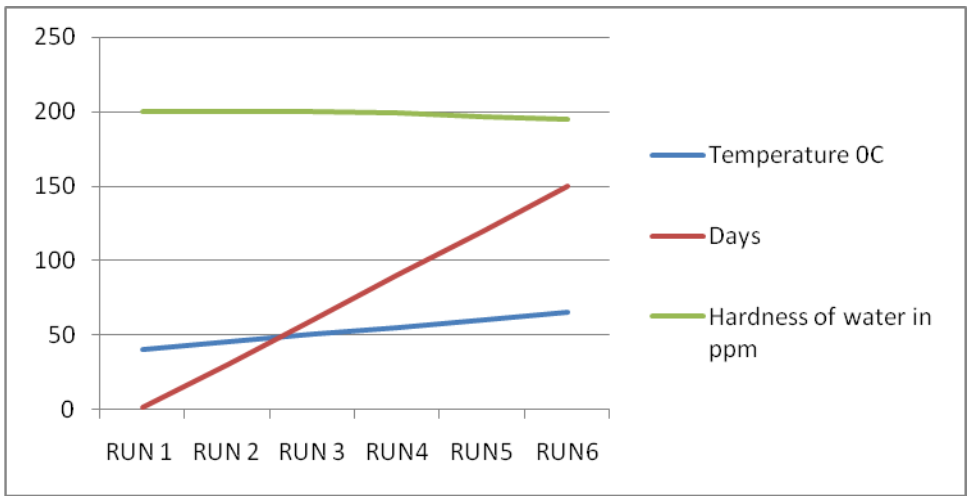

Figure5: Runs with 200 ppm PAA

III. OBSERVATIONS AND DISCUSSIONS:

Hardness of water observed for different runsin the present study with increased in temperature and with increased in concentration of polymer poly acrylic acid at constant flow of hot and cold water in Doubled pipe heat exchanger. The scale deposition was decreases with increased in concentration of in polymer in water.

IV. CONCLUSION:

The corrosion and scaling formation in heat exchange equipment badly affects the efficiency of equipments in process operations. Water solublepolymers are found to act as effective corrosion resistance and ant scaling characteristics. The specific action of inhibition depends on the nature of the metal surface, physicochemical properties of the polymer such as functional groupsand size.Poly-acrylic acid is resourceful anti-scaling agent for removal of temporary hardness of water in heat exchange equipment.

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