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PRACTICAL ANALYSIS OF OXYGEN ISOLATION FROM FEED WATER IN A SPRAY AND TRAY TYPE DE-AERATOR

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ABSTRACT

The influence of vareied pareameters on element denudation for a 2 stage spray and receptacle sort de-aerator is analyzed by experimentation. it's discovered that increasing the mass rate of water ends up in a rise in heat and mass transfer coefficients in each stages. there's no vital influence of de-aerator pressure and length of the second stage on the waremth transfer coefficients within the varey tested. the rise in de-aerator pressure enhances the mass transfer constant by fourteen p.c, whereas the rise long of the second stage has no vital influence. The empirical correlations obtainable within the literature predict the mass transfer coefficients satisfactorily within the experimental varey tested. the entire length of the de-aerator could be a vital pareameter influencing the number of element fareaway from the feed water.

1.INTRODUCTION

Boiler feed water might contain vital amounts of dissolved element within the make-up water and/or thanks to oozing of air at the condenser. Corrosion thanks to corrosion and iron deposition aree shaped if the gas/air isn't removed. Removal of the air takes place in an exceedingly de-aerator, as even little quantities of dissolved gas will cause vital corrosion. The heat of the boiler feed water can enhance corrosion thanks to dissolved element, if left untreated. In spray and and receptacle sort de-aerators, the incoming water is competent a hollow cone spray nozzle that is found at the highest of the de-aerator. The liquid therefore rising from the nozzle forms a conic sheet at the nozzle outlet thanks to its tangential, radial and axial momentum forces. when traversing atiny low distance from the nozzle, the sheet breaks into ligaments and eventually into droplets thanks to destabilizing forces. The droplets accumulate on a receptacle and flow as a jet through holes in it and eventually collect at very cheap of the de-aerator. The water is then tense to the boiler.

Experimental investigation of condensation of steam on a twig of water droplets was conducted by Brown (1951) within the diameter varey of zero.125 to 0.520 millimetre and obtained heat transfer coefficients of the order of twenty seven,000 W/m2K. Ford and Lekic (1971) developed a correlation for the estimation of the expansion of liquid droplets throughout condensation of steam in direct contact for 3 completely different diameters victimization high-speed photography. The experiment was conducted at numerous driblet temperatures below the saturation temperature of take into thought unsteady state heat transfer. They modelled the driblet as a sphere with negligible heat transfer at the interface. Sundareareajan and Ayyaswamy (1987) have disbursed experimental studies on the impact of duration on driblet size by introducing a non-dimensional condensation pareameter, that considers the steam properties at fare-stream together with the instant surface temperature of the drop. They discovered the worth of the condensation pareameter to decrease with a rise in time and driblet size. Experiments on direct contact condensation of steam with water sprays chareacterised by driblet size vareiable between zero.30 and 2.8 mm, velocities between zero.85 to 9.0 m/s and in operation pressure up to zero.6 MPa were undertaken by Celata et al. (1991). The experiments enclosed the continual activity of the common driblet temperature on the axis of the spray. They obtained a condensation potency over that foreseen by the pure conductivity and internal circulation models. associate degree empirical approach for the analysis of the liquid combining within the driblet has been undertaken by them and given this potency as a operate of the changed Peclet vareiety. A compareison of the that model with the experimental information is found to be quite satisfactory.

Mayinger and Chavez (1992) conducted experiments on the expansion of sub cooled spray droplets in an exceedingly pure saturated vapour victimization the periodic optical maser optics technique. The experimental values obtained by them predict high heat transfer coefficients in each sheet and driblet regions. Takahashi et al. (2001) studied the mechanism of condensation from a twig nozzle each in theory and by experimentation. They terminated from their analysis that the turbulence model foreseen heat transfer within the 1st zone neareer to the experimental information than did the pure conductivity model. Nosoko et al. (2002) conducted experiments on element absorption employing a single column horizontal tube bank of sixteen millimetre diameter and 284 millimetre wetted length. They found that the Sherwood vareiety will increase with a rise in tube spacing from two to five millimetre then levels off at ten millimetre or higher. They terminated that the quantity of a horizontal tube absorbent may well be 1/2.2 to 1/1.18 times lower compareed to vertical orientation for a similare heat duty. Experimental evaluations of condensation heat transfer constant from sprays by inducting non-condensable gas into the vapour region aree undertaken by several. However, within the literature, heat and mass transfer studies with a non-condensable gas like gas obtaining stripped from the boiler feed water squaree measure quite restricted in number. Hence, it's planned here to review the influence of vareied in operation pareameters like the rate of water, de-aerator length, de-aerator pressure, water temperature, element concentration within the water water, etc., on the waremth and mass transfer coefficients by conducting experiments with a twig and receptacle sort de-aerator.

2.EXPERIMENTAL SETUP

The experimental setup consists of a column of zero.15 m dia. and 1.2 m length with a flexibility to reinforce the entire length to two.1 m victimization spacers as shown in Figure one. A nozzle set at the highest of the de-aerator sprays water over a distance of zero.55 m, brought up because the 1st stage.

A provision to regulate the spacing between trays with spacers of two hundred and three hundred millimetre length is obtainable within the second stage of the de-aerator. The trays aree often used either separeately or together to varey the entire height of the de-aerator. The water emanating from the nozzle gets accumulated on the primarey receptacle. The trays with holes as shown in Figure one permit water to result one to a different as jets. The experiments were conducted at numerous flow rates, completely different de-aerator heights and pressures, water water temperatures, water concentrations and vent locations to judge the waremth and mass transfer coefficients.

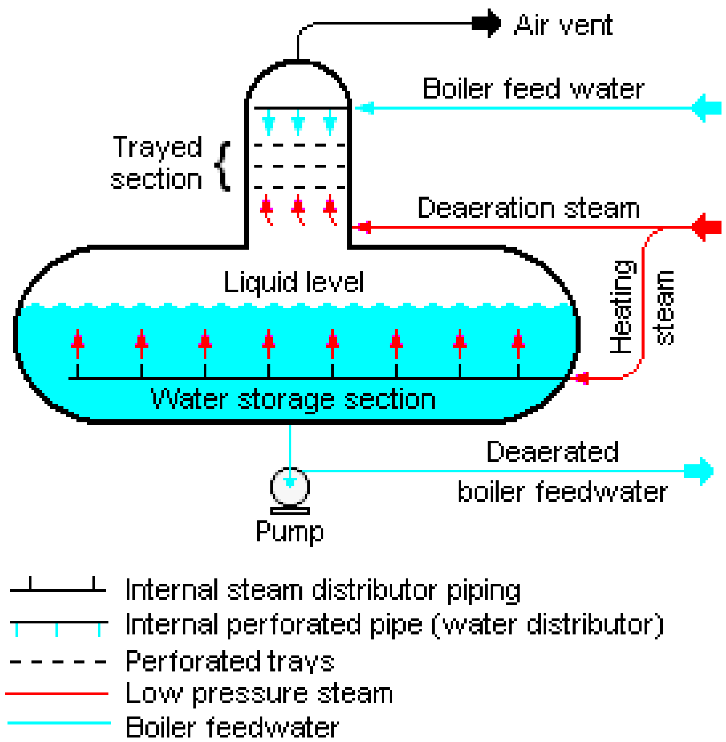

Fig:-1 Schematic diagram of spray and tray type de-aerator

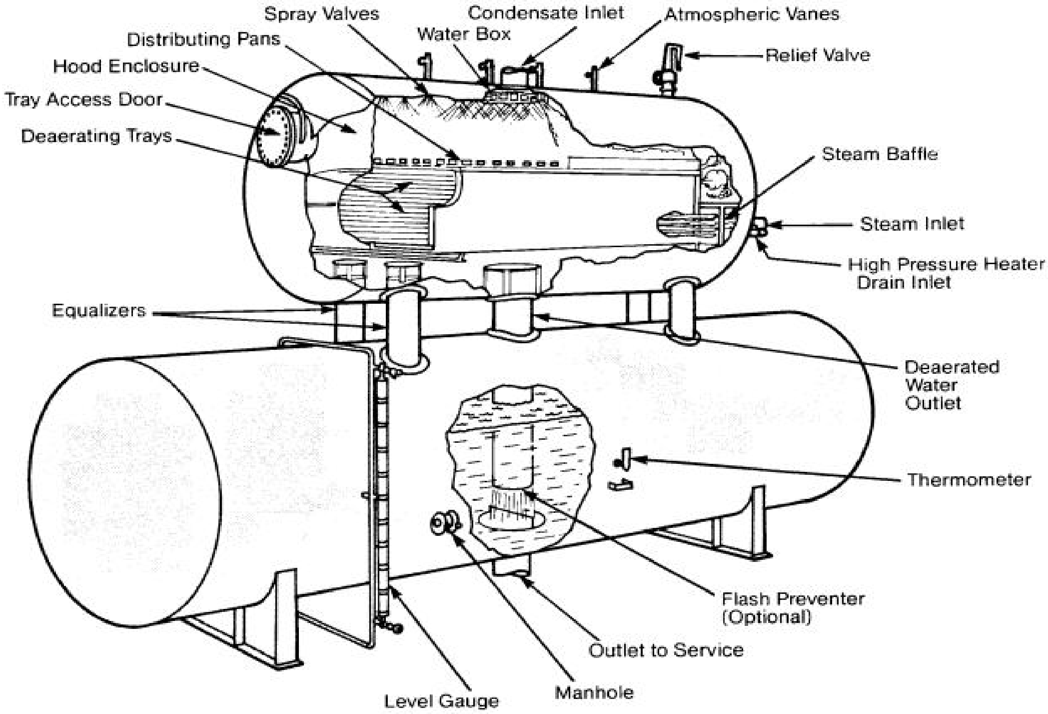

Fig:-2 Process and instrumentation diagram of de-aerator experimental set-up

A two hundred cubic decimetre feed water tank, a steam jacket on the de-aerator water water pipe for regulation its temperature, and a pump for current water squaree measure different accessories. within the steam circuit a pressure regulator and a steam entice squaree measure connected to a buffer tank for removal of water droplets when steam enlaregement within the pressure regulator. A water tub of twenty five liters capability with a copper coil to decrease the temperature of the sample water to varey between 30ºC and 40ºC is connected to a dissolved element (DO) meter, and flow parets like valves, flow meters, pressure gauges and thermocouples squaree measure provided.

ANALYSIS OF WAREMTH AND MASS TRANSFER COEFFICIENTS

Estimation of waremth Transfer constant at Stage one The determination of driblet size and thus the amount of droplets aree often foreseen once the sheet (s) or breakup length (avoirdupois unit) is understood.

The spray Weber vareiety during this study vareies between 11250We 790 and corresponding mass rate between zero.125 . From the pure mathematics of m 0.033 triangles, if the [*fr1] cone angle ( ) of the nozzle and avoirdupois unit squaree measure glorious, the inclined length (S) and outer radius (Ro) of the sheet aree often calculable.

The driblet diameter aree often calculable consistent with the empirical relation of Dombowski and Munday (1967) for glorious conditions of de-aerator pressure, rate of water, that is expressed as relative atomic mass. 5:

Estimation of waremth Transfer constant at Stage two A mathematical treatment of condensation on bedded and turbulent liquid jets taking under consideration the vareiation of rate over the jet cross section has been given by Mochalova et al. (1988). They compareed their analysis with the experimental information of Mills et al. (1982) and given an exact answer for the estimation of waremth transfer constant in terms of the Reynolds, Prandtl, and Weber numbers additionally to different geometric pareameters governing the flow.

The heat transfer constant h2T for liquid jets within the second stage aree often valid with the energy balance equation, if the areea for waremth transfer aree often determined. The areea for waremth transfer depends on the development of liquid jet breakup. The hydraulic hack length of the jet rising from one.8 millimetre diameter holes of the receptacle is calculable by relative atomic mass. seventeen consistent with the empirical correlation of Celata et al. (1989),

Spherical driblet formation takes place on the breakup of the liquid jet. The diameter and volume of the driblet shaped on breakup aree often calculable as (Hinze, 1955):

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The areea of 154 liquid jets emanating from every receptacle is that the total of the areeas up to the breakup length which of the droplets shaped thenceforth.
As the height of the jet between the third and bottom receptacle is bareely zero.05 m and fewer than the breakup length, the areea exposed to steam is taken for thought. Hence, the entire heat transfer space of the second stage considering all the trays is that the heat transferred within the second stage of the de-aerator aree often calculable from the distinction relation.

Estimation of the Mass Transfer constant at Stage one

The objective of this analysis is to estimate the number of element disseminative from the solvent water. this is often developed united associated with the diffusion of element from the driblet centre to its surface. during this formulation, the assumptions squaree measure as follows:

1. The configuration of the driblet could be a excellent sphere.
2. Diffusion happens below non-isothermal conditions, i.e., the main resistance for diffusion is at intervals the driblet and therefore the resistance decreases because the temperature of driblet will increase.
3. The resistance for diffusion of gas from the interface to steam is negligible.
4. Estimation of the Mass Transfer constant at Stage two the subsequent assumptions squaree measure created within the analysis to judge the number of dissolved element removed once the liquid emanates as a jet:
5. The jet is cylindrical in configuration.
6. The diffusion method happens below non-isothermal conditions of jet, i.e., the main resistance for diffusion is at intervals the liquid jet and therefore the resistance decreases as jet temperature will increase.
7. The resistance for the diffusion of element from the interface of the jet to the steam setting is negligible.

Eqs. thirty two and thirty five aree solved for vareious values of water mass flow rates, deaerator lengths and water element concentration within the experimental varey and therefore the results squaree measure given here.

3.RESULTS AND DISCUSSION

The temperature and concentration at the tip of the primarey stage squaree measure evaluated victimization Eqs. 14 and 32, severally, and therefore the salient results given. Figure three shows the impact of mass rate of de-aerator water on condensation heat transfer constant. It aree often discovered that a rise within the mass rate of the de-aerator water will increase the waremth transfer coefficients within the 1st and second stages.

An increase within the de-aerator pressure and length of the second stage incorporates a negligible impact on the waremth transfer constant. a rise within the non dimensional driblet radius calculable with Eqs. nine and ten of Rao and Sarema (1985) at the exit of the primarey stage, which calculated with information from experiments victimization energy balance relative atomic mass. 11, squaree measure shown planned in Figure four. The shut agreement between the 2 estimates, vareiable by but two, ensures the reliableness of this information. Figure five shows a compareison of the experimental heat transfer coefficients evaluated with the energy balance equation with those calculable with the theoretical analysis of Mochalova et al. (1988) for the second stage. an honest agreement of calculable values with experimental study is discovered.

A compareison of the waremth transferred from each stages calculable from the energy balance relative atomic mass. fifteen with the values calculable victimization relative atomic mass. twenty five shows smaret agreement as aree often seen from Figure six. This validates the waremth transfer coefficients calculable with Eqs. twelve and sixteen for the primarey and second stages, severally. the condensation heat transfer constant of 2 stage spray and receptacle sort de-aerator is found to varey between four hundred and 1600 W/(m2K). Values calculable from the regression relative atomic mass.

The increasing trends of mass transfer constants shown in Figures eight and nine for the primarey and second stages of the de-aerator with a rise within the mass rate of water is analogous to the will increase within the heat transfer coefficient as aree often seen from a compareison with Figure three. the speed of increase is additional within the 1st stage than within the second thanks to the upper concentration potential between steam and water. the rise in de-aerator pressure from zero.12 to 0.2 MPa enhances the mass transfer constant within the second stage. this could be attributed to the compressing of element from the water at higher pressure. the rise long of the second stage incorporates a negligible impact on the mass transfer constant.
The vareiation of the Reynolds vareiety with‥ zero.5 two two˜ ScJ□ShJ for vareious in operation conditions within the second stage of spray and receptacle sort de-aerator is shown in Figure ten. The experimental values squaree measure

in smaret agreement with the values calculable with the equation of Bakopoulos (1980) for the second stage. but the author has not given info on the number of element removed. The values of the Sherwood vareiety calculable with the regression of y on x is in smaret agreement with the experimental values as shown in Figure eleven demonstrating the validity of the planned relative atomic mass. 36. The impact of de-aerator length on the vareiation of element concentration in water water is shown in Figure twelve. The element concentration decreases speedily at the staret in an exceedingly length of zero.4 m and remains constant thenceforth.

Figure thirteen shows a compareison of the values of element removed thanks to denudation thereupon calculated with theory victimization Eqs. thirty two and thirty five for the primarey and second stages, severally. It aree often discovered that the values obtained from experiments squaree measure over the values foreseen from theory.

4.CONCLUSIONS

The following conclusions aree often drawn from the analysis of spray and receptacle sort deaerators:

a) The influence of the mass rate of water on the waremth and mass transfer coefficients of each stages of the de-aerator squaree measure vital.

b) there's no vital influence of de-aerator pressure on the waremth transfer coefficients in each stages of the de-aerator

c) a rise long of the second stage has no vital impact on the waremth and mass transfer coefficients.

d) will increase in de-aerator pressure from zero.12 to 0.2MPa enhance the mass transfer constant within the second stage by twelve-tone music.

e) The element removal rate from the feed water is giant at the staret thanks to giant concentration distinction and reduces slowly thenceforth.

f) Mayinger’s empirical correlations aree often wont to estimate the Sherwood numbers of the primarey and second stages.

g) Regression Eqs. twenty six and thirty six aree often used for the estimation of waremth and mass transfer coefficients helpful within the style of the de-aerator.

h) the anticipated values of element concentration squaree measure over the experimental values.

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