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Improvisation of Clean-In-Process for Paint Filling Machine in Paint Manufacturing Industries

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ABSTRACT
In many paint manufacturing industries shade variation is the main problem because of inefficient cleaning in the paint filler machines. Some of the industries were using manual cleaning method which is inefficient. In some well-developed paint production industries they used an automated Clean-In-Process (CIP). Although, this automated CIP was giving good results at the time of installation, it also becomes less effective due to tank cleaning nozzles getting choked when it was dipped in the paint or while filling various types of shades, it gets splashed all around the hopper and nozzles and to occurrence of pressure drop in the pipe lines. To overcome these problems by using an effective 360° rotary nozzle is designed for cleaning the interior surfaces. It is powered entirely by the cleaning water and it requires no electricity, compressed air or lubricant for operation. By establishing the cleaning water source as near to filler machine the pressure drop problem will be reduced and the given pressure will be obtained at the end of nozzle with same size of pipes and reduced bends. Due to the implementation of the work which is mentioned in this paper, shade variation is completely reduced and the quality of the paint is maintained. The tank was cleaned in less than 5 minutes and attained the capacity of removing dry paint, reducing operating time and costs.

KEYWORDS: Rotary Nozzle, Clean-In-Process, Shade Variation.

INTRODUCTION

In many paint manufacturing industries shade variation is the main problem because of inefficient in cleaning the paint filler machines. Some of them are a using manual cleaning method which is not sufficient. In some well-developed paint production industries they used an automatic clean-in-process.The CIP was referred using [1]Although, this automated CIPwas giving good results at the time of installation, it also becomes less effective due to the occurrence of pressure drop in the pipe lines and tank cleaning nozzles getting choked when it was dipped in the paint or while filling various types of shades, it gets splashed all around the hopper and nozzles. The serac washing method is generally composed of jets directed at the nozzles and container support platforms, as well as the jets inside the tank. The jets have a fixed position. Sweeping of the entire surface to be cleaned is achieved by revolving the filling shaft during the cleaning operation. The function does not include any valve or automation. To overcome these problems use of high pressure nozzle is suggested and to make resistance with paints anti-graffiti coatings are suggested. By establishing the cleaning water source as near to filler machine the pressure drop problem will be reduced and the given pressure will be obtained at the end of nozzle with same size of pipes and reduced bends.

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A. Problem Statement:

The problem is noticed at SERAC BULK Was shown in Fig.1 in that machine hopperwas not cleaned properly by Automated CIP(Cleaning In Process) for every shade change. Tank cleaning methods and apparatus was refered using[2].Due to this, shade variation will occur that will affect the quality of the paint. Automated CIP is not working properly because the water spraying nozzle got choked & large amount of pressure drops occurs in the system.Spray Nozzle was referred using [3]. Due to this, Manual CIP is followed which is less efficient for cleaning and it consumes more time and man power.Strainer cleaning process was not done now .so that a large amount of paint gets mixed up with next batch Paints which got dried over the vessel can't be removed easily. Pipeline used for supplying water is not in same dimensions(Convergent-divergent-convergent) & which has many bends and the length of the pipe is too long from the machine due to this pressure drop will occur.Rotating drum principles were refereed using[4].

Fig. 1: Hopper.

B. Shade variation:

It is define as color changes between same paint. In other word no form of required paint these are cause due to the improper cleaning of filling machine, mixer and adding improper emulsion. Fig.2 shows the shade variation

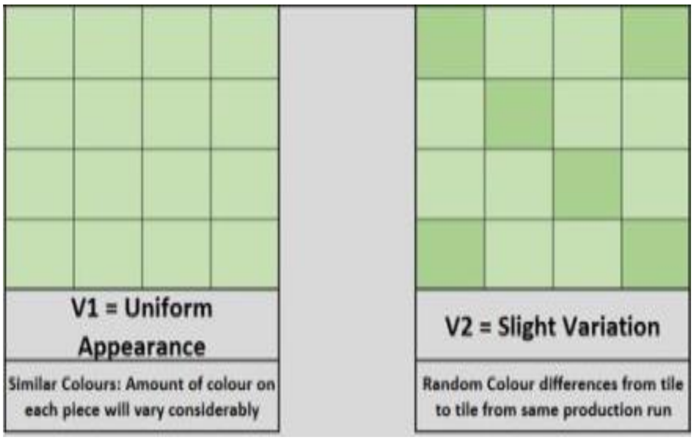

Fig. 2: Shade variation.

Methodology:

A. Schematic Diagram

The schematic diagram shows in Fig.3 represents the flow of process for the objective which is done for this paper.

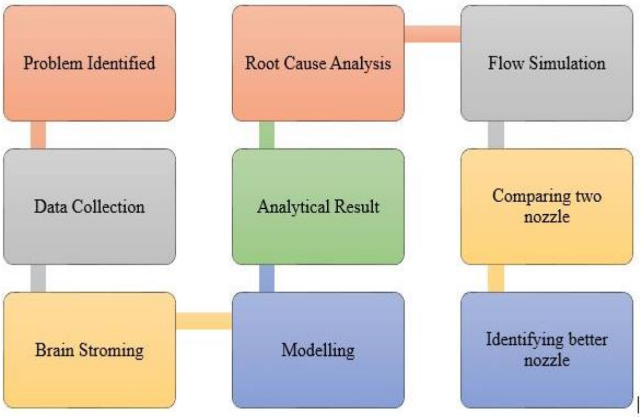

Fig. 3: Process flow diagram.

B. Data surveys:

In data surveys, a fishbone analysis for shade variation problem using man, machine, material and method followed in the plant. Fig .4 shows analysis of shade variation.

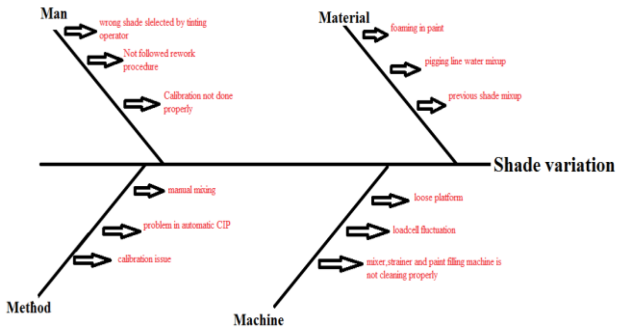

Fig. 4: Fishbone Analysis.

C. Last three years data:

The data is collected about last three year customer complaints about shade variation and find that the shade variation is increasing year by year -there is no reducing in complaints. Fig.5 shows the comparison of last three year complaint details about customer complaint.

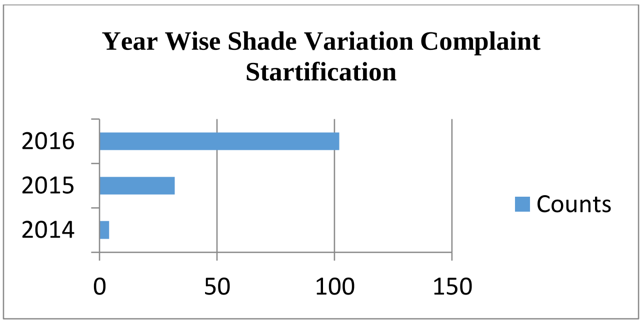

Fig. 5: Customer complaints.

D. Checking Methodology:

In quality section they find the quality of the paint by checking the opacity, v, and reduce in strength of the paint.

1) Opacity:

The opacity or hiding strength of a paint describes how it interacts with light. Opaque paints are more reflective. They cover and hide what's under them. Transparent (or translucent) paints allow more light to pass through them. Fig.6 shows the opacity checking card of the paint and the checking methodology.

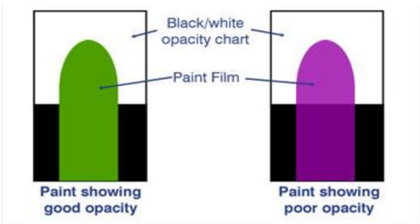

Fig. 6: Opacity.

2) Reduce in Strength:

Tinting strength is a measure of the ability of a colorant to alter the color of a paint film. Hiding power and tinting strength are two optical properties used to describe the light-scattering efficiency of a white pigment. While hiding power is a measure of the ability of TiO_2 to opacity a white paint film, tinting strength describes its ability to add whiteness and brightness to the color of a tinted paint. The tinting strength test describes TiO_2 light-scattering contribution relative to the light absorbing ability of a colored pigment when a white paint is tinted to about 50% reflectance with the colored pigment. Fig.7 shows the reducing strength. To be sure that flocculation does not give misleading tinting strength results, the tinting strength measurement should be accompanied by some measure of flocculation such as a rub-up test on the partially dried tinted paint.

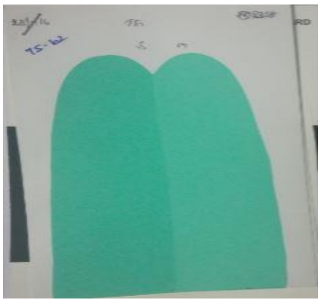

Fig. 7: Reduce in strength.

E. Quality Checking:

The quality of the paint is checked by taking the first sample from the paint filling machine .We check the quality by comparing the opacity, reduce strength and visual difference of the sample with the master .Table 1 shows that the samples we compare with the master for quality checking.

Table I: QUALITY CHECK

S.NO	SHADE	BATCH NO	PREVIOUS BATCH	SHADE VARIATION
1	TE1	S8318	Wall Primer	yes
2	TE1	S8316	ACE AC7G	yes
3	TE6	S1850	TE1	yes
4	ACE EXT AC2G	S1773	TE1	yes
5	Royale RAWT	S23	-	yes

Design and suggestion:

A. Pressure Drop:

Pressure at the end of the nozzle is less than the input pressure due to this there is inefficient cleaning. Pressure drop is obtained because of the sudden contraction, length of the pipe and bend.The pipe bends were referringusing [5].

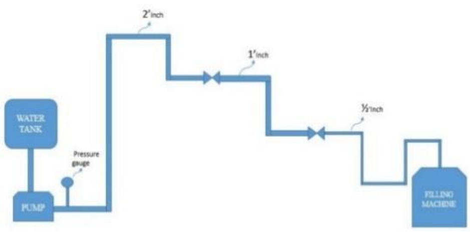

Fig. 8: Pipeline setup Fig.8 shows that general pipeline layout for the clean-in-process

Table II: OBSERVED DATA

S.No	Particulars	Abbreviation	Values	Units
1	Inlet pressure	P	5	Bar
2	Diameter of pipe 1	D1	0.0508	Meter
3	Diameter of pipe 2	D2	0.0254	Meter
4	Diameter of pipe 3	D3	0.0127	Meter
5	Length of the pipe 1	L1	7	Meter
6	Length of the pipe 2	L2	5	Meter
7	Length of the pipe 3	L3	2	Meter

Observed data were tabulated in Table 2.From Weber, Robert .L college physics-4th edition USA coefficient of friction for stainless steel is 0.009
Coefficient of friction, f= 0.009
The formulas were referred using [6]
Pressure Head P = ρgh.
P-Inlet pressure.
ρ- Density of liquid (for water, ρ = 1000kg/m^3).
h- Head of the water tank.
g- Gravity (g = 9.81 m/s^2
Solution,
H = P/ρg.
H = 5*10^5/ (1000*9.81)
H = 50m.
Flow through pipes in series or flow through compound pipes.
The discharge passing through each pipe is same.
$Q=A_1V_1=A_2V_2=A_3V_3$.
W.K.T,

$$H=\frac{0.5V_1^2}{2g}+\frac{4f_1L_1V_1^2}{d_1*2g}+\frac{0.5V_2^2}{2g}+\frac{4f_2L_2V_2^2}{d_2*2g}+\frac{0.5V_3^2}{2g}+\frac{4f_3L_3V_3^2}{d_3*2g}+\frac{V_3^2}{2g}. \quad (1)$$

By using continuity equation,
$A_1V_1=A_2V_2$
$v_2=\frac{\frac{\pi}{4}d_1^2}{\frac{\pi}{4}d_2^2}v_1$
$v_2=3.99v_2$.
$A_1V_1 = A_3V_3$
$v_3=\frac{\frac{\pi}{4}d_1^2}{\frac{\pi}{4}d_3^2}v_1$
$v_3=15.9v_1$.
Subv_2, v_3,$f_1=f_2=f_3$=0.009 and L_1=7m, L_2=5m, L_3=1m in Equation 1
We get,
$H=21.9V_1^2$. (2)
Sub H=50m in Equation 2
We get,
v_1=1.41 m/s.
Sub $v_1$in v_3
We get v_3=22.4 m/s.
We know that, $V_3=\sqrt{2gh_3}$
Sub V_3 in above formula and we get the value forh_3,
h_3=25.28 m.
Head loss =h_1-h_3
Head loss=50-25.28
Therefore Head loss =24.71m.
We know that
Head loss=$\frac{P_1-P_2}{\rho g}$
$P_1 - P_2$= 24.71*1000*9.81
Pressure drop = 2.42*10^5 N/m^2
Therefore pressure drop = 2.42 bar.

Initially the pressure given by the pump will be in 5 bar pressure due to large distance of pipe and bends in pipe causes a pressure drop up to 3 bar pressure.

B. Nozzle Design:

1) Tank jet:

The existing nozzle they used now is Tank jet which is shown in Fig.9.This type of especially suited for CIP system. It provides more impact than static spray balls. The Tank jet is a reactionary force tank cleaning Nozzles for tanks up to 7.6m in diameter. This is ideal for CIP, this nozzle out performs spray balls and offers long wear life for tank cleaning operation.

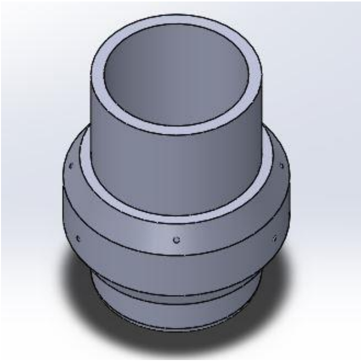

Fig. 9: Tank jet

2) Rotary Nozzle:

The Rotary Nozzle shown in Fig.10, is a high-quality tank cleaning nozzle. Originally designed for tote cleaning applications, the Rotary Nozzle tank cleaning machine is also perfect for other small and mid-sized tank cleaning applications. Patent of Rotary nozzle is referred using [7].

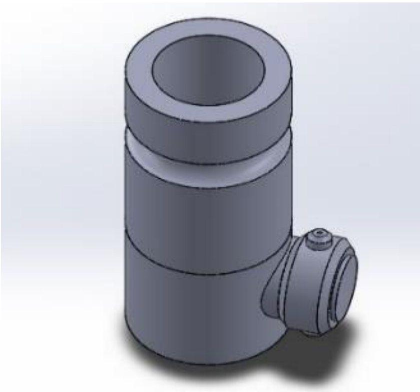

Fig. 10: Rotary Nozzle

C. Cleaning Pattern:

Its 360° spray pattern in Fig.11 provides thorough scouring of the entire tank, reducing operating time and costs. The Rotary Nozzle tank cleaning machine sets the standard for cost-effective impingement tank cleaning.

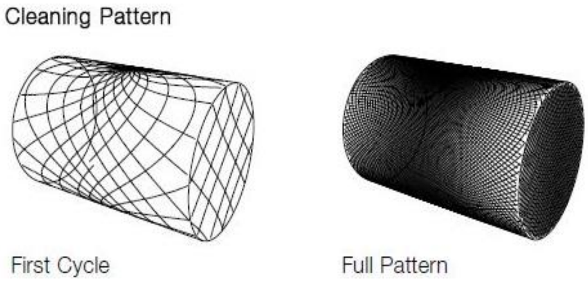

Fig. 11: Cleaning Pattern

D. Flow Simulation:

Aflow simulation using solid works software for the suggested rotary nozzle was shown in Fig.12. By this, it was proved that the pressure obtained at the end of the nozzle is more compared to the tank jet nozzle.

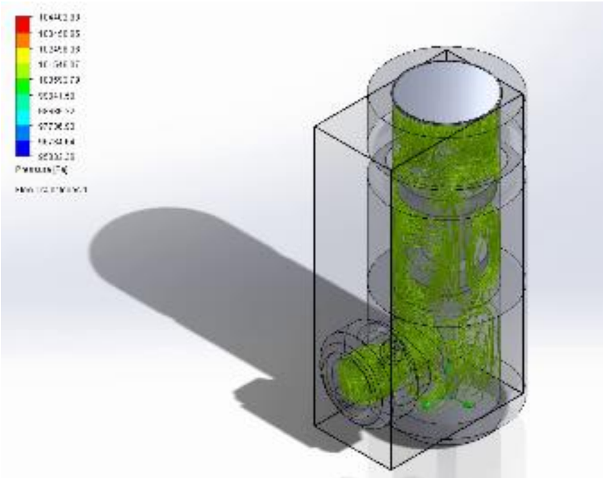

Fig. 12: Flow simulation.

RESULTS AND DISCUSSIONS

To reduce the pressure drop in pipeline by installing separate pump, water tank. Near to the paint filling machine to reduce the bends in pipe. Due to the improper cleaning of the existing nozzle the comparison made between the existing nozzle and suggested nozzle .the suggested nozzle covers total area of the tank and provide a more efficient cleaning then the existing nozzle this will reduce the shade variation .By installing the suggested nozzle, a weekly cleaning of SERAC bulk gives approximately 60Kg of hazardous waste this can be reduced and manpower cost is also reduced.

Conclusion:

Automated Clean-In-Process (CIP) is a process of cleaning the paint filler tank at required amount of pressure with the help of high pressure tank cleaning nozzles. The results from the engineering and economic analysis for the problem of shade variation shows that the suggested tank cleaning nozzle is suitable for cleaning the tank completely and reduces shade variation for the maximum number of pails and also reduces customer complaints. For the choking of nozzles, a pre supply of air at 3 bar pressure will release the sticky paints and clear the holes as well. So, the supply of water will move freely throughout the nozzle and cleans the tank for next shade change. It reduces the wastage, manpower, time consumption for cleaning process. This paper will serve as a predecessor for future development of paint production.

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