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Characterization of wastewater from Surface Coating Industries

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Abstract

Surface Coating Industries are evolving from ages. The main process in these industries is pre-treatment process. The pre-treatment of the metals can be done by either phosphating or nano coating. The waste water generated by these polluting industries causes harmful effect on environment. The purpose of the study is to determine the strength of the pollutants in the waste water generated from the five surface coating industries involving both phosphating and nano- ceramic coating and to compare the results of above processes. The samples where collected from pre-treatment process and analyzed for the following parameters pH, Conductivity, TDS, TSS, BOD, COD, Oil & Grease, alkalinity, acidity, zinc, phosphate, heavy metals such as chromium and nickel. It has been found that the strength of effluent from phosphating process is more when compared to nano coating process and it generates less load on the treatment plant.

Keywords: *Surface Coating facility, Pre-Treatment Process, Phosphating, Nano- Ceramic Coating, Wastewater.*

1. Introduction

The metal surface is generally pre-treated before painting process. This pre-treatment process of metal helps in removing oil & grease, dust, mud from the metal surface and improves the adhesion capacity of the surface, which helps the paint to adhere properly on the surface. The pre-treatment process can be done by phosphating which is in practice since long time. It involves usage of chemicals which are acidic in nature and its generally called as seven tank process, whereas the nano-ceramic coating is the new technology in practice involving alkaline chemicals, it is generally called as five tank process. Five surface coating industries where taken into consideration for this study. Among five industries, three follows nano- ceramic coating process and rest two follows phosphating process. In Phosphating process, chemicals used acidic whereas in nano-ceramic coating the chemicals are alkaline. The waste water from this process is taken for the study. The strength of the wastewater differentiates the above two process. Comparing the parameter concentrations, it can be said which process has least environmental impact. By this waste water characterization, process change can be implemented to the industries following the old process with negative environmental impact.

2. Material and Methodology

The representative samples were taken. The samples were collected from the process areas of five industries in plastic bottle washed with nitric acid and Demineralized water and stored as per the standard procedure [1]. All the chemicals used in the analyses are laboratory grade. The samples have been named as P1 & P2 for phosphating industries and NC1, NC2 & NC3 for nano coating industries. The samples were then tested as per standard procedure for pH, Conductivity, TDS, TSS, BOD (5days at 20℃), COD, Alkalinity, Acidity, oil & grease, zinc, phosphate and heavy metals such as chromium and nickel. The following are the procedures.

2.1 pH Value:

The test method followed is as per IS:3025 (Part II)–1983. pH value was determined by using pH meter. pH values give whether the sample is acidic or alkaline in nature.

2.2 TDS & TSS:

The test was carried by referring IS method. The TDS and TSS has been determined by using gravimetric method.

2.3 BOD and COD:

Bio-chemical Oxygen demand for 5 days at 20 ℃ was determined as per APHA, 5210, B 23rd Edition. Chemical oxygen demand was determined by using reflux method as per EPA Method-4101.

2.4 Alkalinity and Acidity:

Alkalinity and Acidity is determined by titration method as per IS:3025(P-23)-1986 and IS:3025(P-22)-1986.

2.5 Oil & Grease:

It is determined by using gravimetric method as per APHA 22nd Edition 2012 5520

2.6 Chromium & Nickel:

Atomic Absorption Spectrophotometer (AAS) is used to determine both the heavy metals. The sample preparation includes digestion by adding 2ml nitric acid in 50 ml of sample followed by heating on burner until it reduces to 20% then add demineralized water to make it to 50ml and then filter by using whatman filter paper. Then the digested sample is kept in AAS at absorbance of 360nm for chromium and 230 nm for nickel to give absorbance reading.

2.7 Zinc & Phosphate:

The zinc concentration in sample is determined by using Atomic Absorption Spectrophotometer (AAS) as per IS:3025(P-49)-1994. The sample preparation is same as that of above and is set to 460nm, to give the Zn concentration. The amount of Phosphate is determined by visible spectrophotometer as per IS:3025(P-31)-1988 Reaffirmed 2003.

Table 1: Analyses report of Phosphating industries

SI.NO	Parameters	Units	Permissible limit	P1	P2
1	pH value	-	5.5-9 (CPCB)	4	4.5
2	Total Dissolved solids	mg/l	2100 (CPCB)	4346	4312
3	Total Suspended solids	mg/l	45 (EPA 2002)	100	188
4	BOD_5	mg/l	30 (CPCB)	130	159.10
5	COD	mg/l	250 (CPCB)	340	420
6	Alkalinity	mg/l	-	0	0
7	Acidity	mg/l	-	506.68	1146.68
8	Oil & Grease	mg/l	10 (CPCB)	BDL	BDL
9	Chromium	mg/l	0.1 (EPA 2002)	0.378	0.276
10	Nickel	mg/l	0.1 (EPA 2002)	0.154	0.348
11	Zinc	mg/l	2 (EPA 2002)	424	26
12	Phosphate	mg/l	10 (EPA 2002)	0.6	0.06

Table 2: Analyses report of Nano Coating industries

SI. NO	Parameters	Units	Permissible limit	NC-1	NC-2	NC-3
1	pH value	-	5.5-9 (CPCB)	7.5	6.85	9.0
2	Total Dissolved solids	mg/l	2100 (CPCB)	2120	2137	2103.6
3	Total Suspended solids	mg/l	45 (EPA 2002)	50	55	60
4	BOD_5	mg/l	30	40	46.3	40.11

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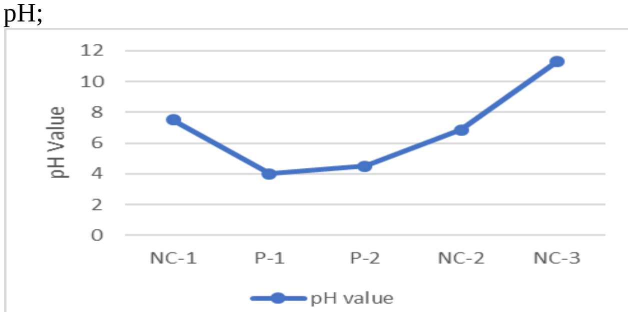
			(CPCB)			
5	COD	mg/l	250 (CPCB)	120	129.64	116.31
6	Alkalinity	mg/l	-	422.66	661.32	460.78
7	Acidity	mg/l	-	0	0	0
8	Oil & Grease	mg/l	10 (CPCB)	BDL	BDL	BDL
9	Chromium	mg/l	0.1 (EPA 2002)	0.1	0.09	0.1
10	Nickel	mg/l	0.1 (EPA 2002)	0.014	0.052	0.018
11	Zinc	mg/l	2 (EPA 2002)	-	-	-
12	Phosphate	mg/l	10 (EPA 2002)	-	-	-

3. Results and Discussion:

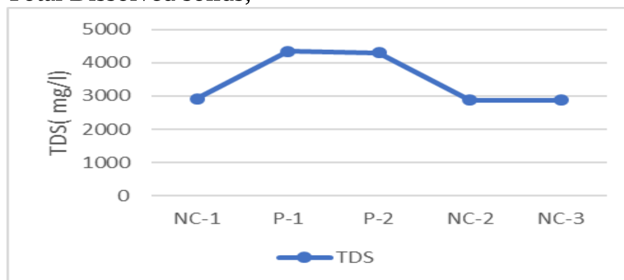
The wastewater samples are analyzed and the results are represented in the form of graph.

pH;



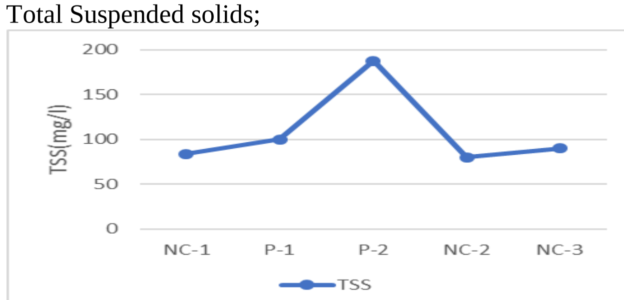
Interferences: The above graph represents the variation of pH values of five surface coating industries. The pH value of phosphating process is acidic in nature and nano coating process is alkaline in nature. The pH value of phosphating process is not within the limit as per CPCB so the wastewater should be treated before disposal or reuse and the pH value of nano coating is within the limit given by CPCB.

Total Dissolved solids;



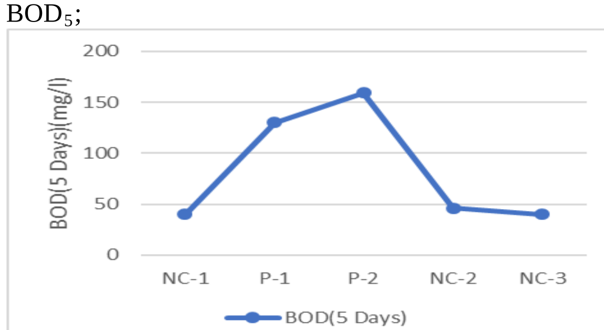
Interferences: The above graph represents the variation of TDS (mg/l) of five surface coating industries. TDS (mg/l) of phosphating process more than that of nano-coating process. The TDS (mg/l) of both the processes is more than the limit given by CPCB so both the wastewater should be treated before disposal or reuse.

Total Suspended solids;



Interferences: The above graph represents the variation of TSS (mg/l) of five surface coating industries. TSS (mg/l) of phosphating process more than that of nano coating process. The TSS (mg/l) of both the processes is more than the limit given by EPA 2002 so both the wastewater should be treated before disposal or reuse.

BOD_5;



Interferences: The above graph represents the variation of BOD_5 at 20 °C (mg/l) of five surface coating industries.

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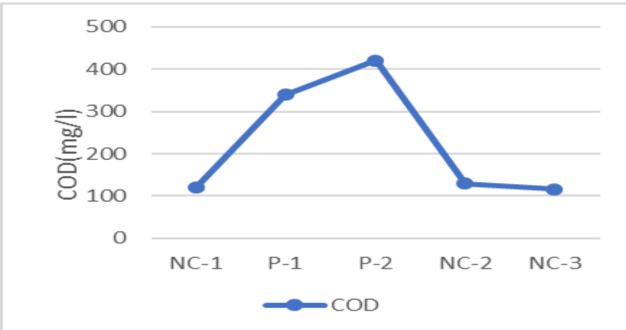
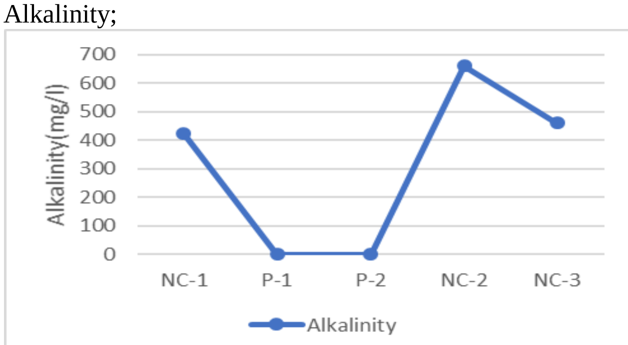
BOD$_5$ at 20 °C(mg/l) of phosphating process more than that of nano coating process. The BOD$_5$ at 20 °C both the processes is more than the limit given by CPCB, so the wastewater has to be treated before disposal or reuse.

COD;



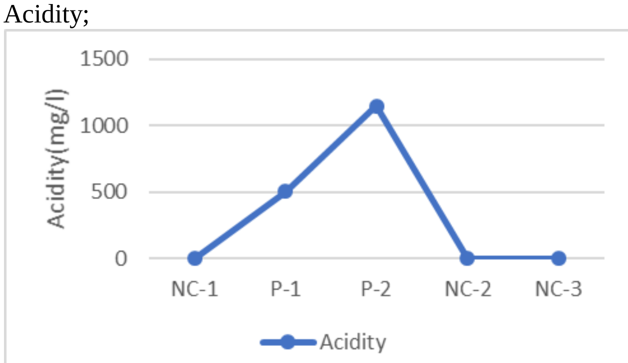
Interferences: The above graph represents the variation of COD (mg/l) of five surface coating industries. COD (mg/l) of phosphating process more than that of nano coating process. The COD value of phosphating process is more than the limit given by CPCB, so the wastewater has to be treated before disposal or reuse.

Alkalinity;



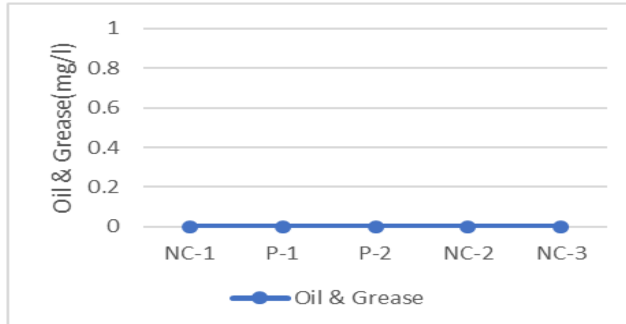
Interferences: The above graph represents the variation of Alkalinity (mg/l) of five surface coating industries. Alkalinity (mg/l) in phosphating process is nil.

Acidity;



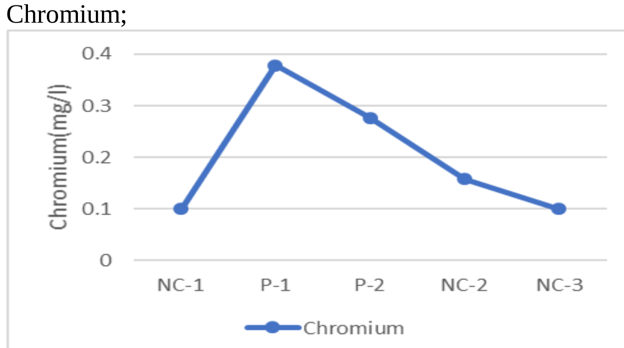
Interferences: The above graph represents the variation of Acidity (mg/l) of five surface coating industries. Acidity (mg/l) in nano coating process is nil.

Oil & Grease;



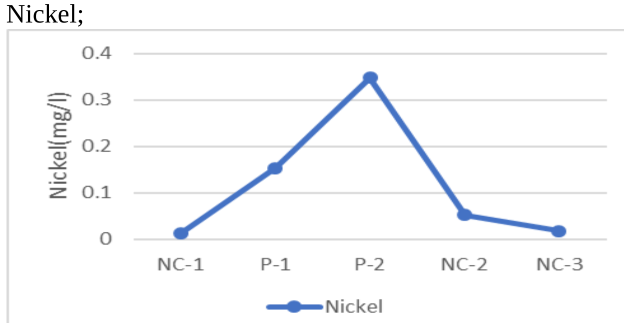
Interferences: The above graph represents the variation of oil & grease (mg/l) of five surface coating industries. oil & grease (mg/l) is found to be nil (BDL). The oil & grease value is within the limit given by CPCB.

Chromium;



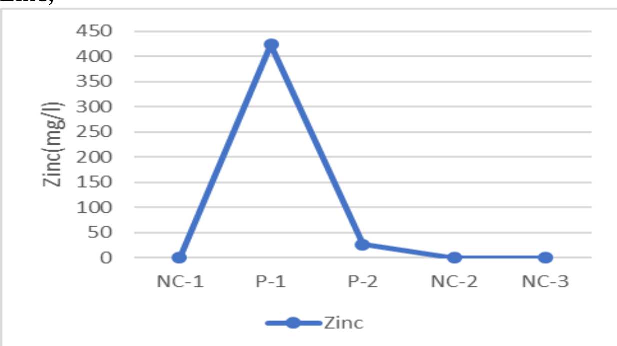
Interferences: The above graph represents the variation of Chromium (mg/l) of five surface coating industries. Chromium (mg/l) in phosphating process is more when compared to nano coating process. The Chromium value of phosphating process is more than the given limit as per EPA 2002 and of nano coating process it is within the limit.

Nickel;



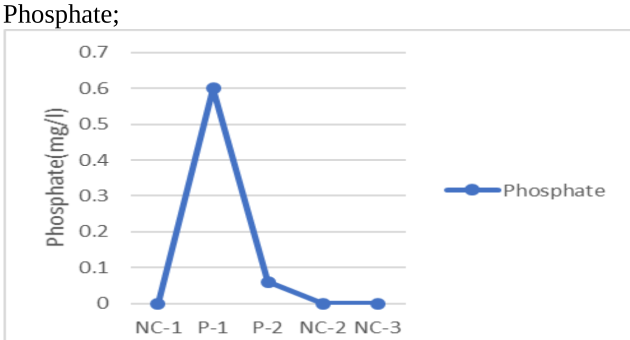
Interferences: The above graph represents the variation of Nickel (mg/l) of five surface coating industries. Nickel (mg/l) in phosphating process is more when compared to nano coating process. The nickel value of phosphating process is more than the given limit as per EPA 2002 and of nano coating process it is within the limit.

Zinc;



Interferences: The above graph represents the variation of Zinc (mg/l) of five surface coating industries. Zinc (mg/l) in nano-coating process is nil. The Zinc value for phosphating process is more than the limit given by EPA 2002, so the wastewater should be treated before disposal or reuse.

Phosphate;



Interferences: The above graph represents the variation of Phosphate (mg/l) of five surface coating industries. Phosphate (mg/l) in nano coating process is nil. The Phosphate value of phosphating process is within the limit given by EPA 2002.

4. Conclusions

The waste water characterization of the five surface coating industries including both phosphating and nano coating processes has been concluded that the strength of the effluent of phosphating process is more than the other process because of the use of acidic chemicals. In order to reduce the load on treatment plant and the environment other green cleaner process such as nano coating should be adopted for the pre-treatment of the metal surfaces. There are many other advantages of nano coating upon phosphating process. Hence, nano coating process represents a major step forward in terms 0f ecological sustainability.

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