Key Elements of Wastewater Technology Management Applicable for Screen Reclamation of Screen Printing Industry

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Abstract: The purpose of this research is mainly focused on the identification of perception on the proposed key elements or components of the wastewater technology management system that can be utilized by micro and small screen printing companies in order to manage the proper handling and disposal of wastewater generated during washing and cleaning of screens or the screen reclamation process. In order to attain the said purpose, survey was conducted to members of six (6) different screen printing organizations who served as either employees or belonged to top management of micro and small screen printing companies. Validated questionnaires were given to the respondents electronically and manually and follow-up interview was made to clarify certain aspects of the study. The key elements identified were focused on the technical and operational requirements of technology acquisition, adoption and innovation including the corresponding policies and guidelines, trainings and seminars pertaining to proper wastewater management compliance.

Keywords: Key elements, Wastewater technology management, Screen printing, Screen reclamation.

I. INTRODUCTION

According to Department of Environment and Natural Resources [1], mismanagement of the generated wastewater during manual screen printing operation specifically in the cleaning or washing of screens (screen reclamation) may expose the company owners and executives to legal responsibilities or accountabilities ranging from possible enforcement prosecutions including but not limited to fines, cleanup costs in relation with environmental liability, and, in worst cases, criminal enforcement [1]. Also, this can cause harmful effects on the health and safety of the workers, declining productivity rate and putting the reputation of the company at stake.

Different industries including screen printing have placed an increasing focus on reducing waste so that there is lesser waste to cope with. This can be done on an industrial level by developing more efficient processes, reducing raw materials, investing in the state-of-the-art machineries and even in advanced waste management technologies [2].

The study emphasized on the key elements of incorporating wastewater technology management system in screen printing operations which would consider the review of the vision-mission, goals/objectives, organizational policies of the company as well as environmental regulations, establishing of wastewater management system, best company practices, process modification, technology acquisition, adoption and innovation, with training program, operation system, maintenance program and monitoring system.

The main objective of the study was to identify the perception of the employees and top management of screen printing companies on the key elements or components of the wastewater technology management system that can be utilized by small and micro screen printing companies.

II. METHODOLOGY

The descriptive research design was used in this study. Micro and small screen-printing companies were the main focus of the study. The one hundred forty-six (146) respondents came from the members of the six (6) different organizations such as the Philippine Screen Printing Association (PSPA), Association of Screen Printers in the Philippines (ASPP), Screen Printing Advocates Worldwide (SPAW), T-shirt Printing Expert Philippines (TPEP), Print Pinas Group (PPG), and Silkscreen Printing Group (SPG) as well as respondents from Metro Manila who were considered under the category of micro and small-sized enterprises and that are involved in executing manual screen-printing in textiles or fabrics.

The respondents were given the validated survey questionnaires which were mailed and/or linked electronically to the members of the six (6) mentioned organizations. Hard copies were given personally to the rest of the respondents and interviews were also conducted to clarify such matters. Data and results were presented through descriptive statistics.

The sampling technique that was used in the study was purposive sampling. The researcher consciously selected the members of the mentioned screen printing organizations who participated in the survey proper based on variety of criteria.

III. RESULTS AND DISCUSSIONS

Table 1 shows the summary of the responses of the employees on key elements of the wastewater technology management that could be utilized for screen reclamation of the screen printing industry. The element that got the highest rating (mean = 4.37) pertains to best company practices during screen printing process under Wastewater Management System while the element that got the lowest (mean = 3.95) is the establishment of environmental management committee for the compliance in environmental regulations also under the same component. Perhaps, the concern for the necessity of the establishment of an environmental management committee was the primary reason behind the lowest rating given by the employees due to the perception of leniency of the proper authorities in the implementation of the environmental regulations [3].

TABLE I: MEAN OF RESPONSES OF THE EMPLOYEES ON KEY ELEMENTS OF THE PROPOSED WASTEWATER TECHNOLOGY MANAGEMENT FOR SCREEN RECLAMATION OF SCREEN PRINTING INDUSTRY

Key Elements	Mean	Standard deviation	Interpretation
A. Goals/Objectives 1. Purpose of wastewater management	4.08	0.75	Agree
2. Alignment with vision-mission of company	3.99	0.74	Agree
B. Wastewater Management System 1. Environmental regulations 1.1 Environmental regulation compliance	4.10	0.75	Agree
1.2 Environmental Management Committee	3.95	0.74	Agree
1.3 Environmental awareness and concern seminar	4.04	0.80	Agree
1.4 Periodic wastewater laboratory analysis	3.95	0.81	Agree
2. Organizational Policy/Guidelines 2.1 Guidelines on prevention and minimization of wastewater	4.16	0.79	Agree
2.2 Policy on generation and monitoring of wastewater	4.11	0.75	Agree
2.3 Policy on treatment and disposal of wastewater	4.17	0.76	Agree
2.4 Other policies related to wastewater management	4.04	0.79	Agree
3. Best Company Practices 3.1 Ink management	4.35	0.70	Agree
3.2 Raw material consumption	4.27	0.75	Agree
3.3 Screen printing process	4.37	0.64	Agree
3.4 Screen reclamation process	4.25	0.71	Agree
3.5 Good Housekeeping	4.42	0.68	Agree

C. Screen Reclamation Process and Technology Modifications 1. Change in raw material: - Use of all-in-one cleaning solution	4.05	0.81	Agree
2. Technology adoption: - high pressure water spray - dip tank - washout booth - filtration equipment	4.11	0.79	Agree
3. Training program	4.23	0.78	Agree
4. Operation system	4.14	0.75	Agree
5. Monitoring system	4.13	0.78	Agree
6. Maintenance program	4.17	0.76	Agree
Over-all Mean	4.15	0.75	Agree

Legend:

Mean Range	Interpretation
4.51 – 5.00	- Strongly Agree
3.51 – 4.50	- Agree
2.51 – 3.50	- Neutral
1.51 – 2.50	- Disagree
1.00 – 1.50	- Strongly Disagree

Employees perceived that best company practices must be observed in a wastewater technology management in a screen printing particularly good practices in ink management, raw material consumption, housekeeping and screen printing aside from screen reclamation. The said component got most of the high ratings with means ranging from 4.25 to 4.42. As for changing the process of washing and cleaning of screens as well as shifting to the use of all-in-one cleaning solution (mean = 4.05) and technology adoption of high pressure water spray, dip tank, washout booth and filtration equipment (mean = 4.11), employees also agreed to these as same as with other elements to be part of the said proposed system.

In totality, the components under Objectives, Wastewater Management System, and the Screen Reclamation Process and Technology Modifications were given a mean rating of 4.15 and agreed upon by the employees to be included as main components of the proposed management.

Table 2 shows the summary of mean of the responses from the top management on key elements of the proposed wastewater technology management for screen reclamation of screen printing industry. Same with the employees, the top management also gave the highest rating of 4.44 for good housekeeping under the component that got relatively high ratings with means of 4.26 to 4.44, the best company practices. On the other hand, the element that got the lowest rating with the mean of 3.99 is the idea of subjecting the generated wastewater to periodic laboratory analysis. This is possibly due the perception of the top management on the additional expenses that would be incurred by the printing company/business once this had been made. In terms of the change in raw material and technology adoption, these were rated with the average of 4.09 and 4.07, respectively.

All the key elements of the proposed wastewater technology management for screen reclamation of the screen printing industry that were detailed and specified in the table were rated and interpreted as "agree" which connotes that the perceptions of the top management concurred with the components of the proposed wastewater technology management with an over-all rating of 4.20.

The means of the responses of both employees and top management on the key elements of the proposed wastewater technology management were subjected to t-test analysis under two samples assuming unequal variances. The results in Table 3 shows the p-value of the two-tailed test rounded off to 0.20 which implies that there are no significant difference between the perceived key elements of the employees and the top management on the proposed wastewater technology management.

TABLE II: MEAN OF RESPONSES FROM THE TOP MANAGEMENT ON KEY ELEMENTS OF THE PROPOSED WASTEWATER TECHNOLOGY MANAGEMENT FOR SCREEN RECLAMATION OF SCREEN PRINTING INDUSTRY

Key Elements	Mean	Standard deviation	Interpretation
A. Objectives 1. Purpose of wastewater management	4.11	0.65	Agree
2. Alignment with vision-mission of company	4.00	0.80	Agree
B. Wastewater Management System 1. Environmental regulations 　1.1Environmental regulation compliance	4.24	0.69	Agree
1.2 Environmental Management Committee	4.03	0.78	Agree
1.3 Environmental awareness and concern seminar	4.20	0.79	Agree
1.4 Periodic wastewater laboratory analysis	3.99	0.84	Agree
2. Organizational Policy/Guidelines 　2.1 Guidelines on prevention and minimization of wastewater	4.26	0.72	Agree
2.2 Policy on generation and monitoring of wastewater	4.16	0.75	Agree
2.3 Policy on treatment and disposal of wastewater	4.23	0.80	Agree
2.4 Other policies related to wastewater management	4.09	0.76	Agree
3. Best Company Practices 　3.1 Ink management	4.39	0.73	Agree
3.2 Raw material consumption	4.26	0.79	Agree
3.3 Screen printing process	4.39	0.64	Agree
3.4 Screen reclamation process	4.30	0.69	Agree
3.5 Good Housekeeping	4.44	0.65	Agree
C. Screen Reclamation Process and Technology Modification 1. Change in raw material: - Use of all-in-one cleaning solution	4.09	0.79	Agree
2. Technology adoption: - high pressure water spray - dip tank - washout booth - filtration equipment	4.07	0.79	Agree
3. Training program	4.27	0.76	Agree
4. Operation system	4.23	0.75	Agree
5. Monitoring system	4.21	0.74	Agree
6. Maintenance program	4.21	0.76	Agree
Over-all Mean	4.20	0.75	Agree

Legend:

Mean Range	Interpretation
4.51 – 5.00	- Strongly Agree
3.51 – 4.50	- Agree
2.51 – 3.50	- Neutral
1.51 – 2.50	- Disagree
1.00 – 1.50	- Strongly Disagree

TABLE III: T-TEST ANALYSISI OF KEY ELEMENT OF PROPOSED WASTEWATER TECHNOLOGY MANAGEMENT

	Employees	*Top Management*
Mean	4.146667	4.198571
Variance	0.017183	0.015963
Observations	21	21
Hypothesized Mean Difference	0	
df	40	
t Stat	-1.306472	
P(T<=t) two-tail	0.198855	
t Critical two-tail	2.021075	

IV.   CONCLUSION

The key elements that were identified for the adoption of the proposed wastewater technology management system concentrated on the technical and operational requirements of technology acquisition, adoption and innovation such as in the operation, monitoring and maintenance programs including the corresponding policies and guidelines, trainings and seminars needed, as well as the government and environmental laws and regulations pertaining to proper wastewater management compliance. Among the areas or aspects stated, the employees and top management of micro and small printing companies recognized that the most vital element in establishing wastewater technology management applicable for screen reclamation conducting manual screen printing operation is the best company practices in observing wastewater management system. Screen printing managers must strengthen best practices implemented within the companies or benchmark other company practices particularly in the aspects of ink management, raw material consumption, good housekeeping and most especially in screen printing operation as well as in screen reclamation process.

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