

Study on Identification and Evaluation of Environmental Factors in Bottled Water

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Abstract. In order to effectively control the environmental factors and improve the environmental performance of enterprises, This article applies ISO14001 environmental management system thought, principle and method to analyze the environmental problems of bottled water production process, Taking a bottled water enterprise as an example, identify the environmental factors by applying the process analysis method, evaluate environmental factors using the multi-factor method, identify major environmental factors, so as to provide a reference for the small and medium-sized bottled water enterprises establishing targeted environmental management program.

Introduction

Bottled water, easy to drink and giving people the sense of security of water quality, is popular with the family, enterprises, social groups. With the price of drinking fountains reducing continuously, the bottled water sales market expand further, and the bottled water enterprises in the entire country's is driven to develop rapidly. Bottled water enterprises bring convenience to people, and the environmental impact caused by them cannot be ignored. According to the process of the aquatic products, bottled water can be divided into pure water, mineral water, distilled water, reverse osmosis water, space water, high oxygen water, active water and ecological water [1], and the bottled purified water is dominant. Regional bottled water companies usually don't have specialized personnel manage environment work, it also not establish effective control mechanism. For the status of environmental management is weak in the small and medium-sized bottled water business, this article take a bottled purified water enterprise belonged to a region of Hebei Province for example. Analysis and evaluate the key environmental factors of production process so as to provide a scientific method for enterprises identifying and evaluating environmental factors, and the basis for the development of targeted environmental control programs.

The Theoretical Basis of Identification and Evaluation of Environmental Factors

The identification and evaluation of environmental factors is the core content of the establishment of environmental management system[2]Life Cycle Assessment has been introduced into ISO14001: 2015 standard, which provides the basis for Planning, Implementation and Operation, Inspection, Improvement (PDCA), such as planning environmental policies and objectives, developing environmental management plans, implementing operational controls, contingency plans and monitoring and measuring them, all that are based on the identification and evaluation of environmental factors, and therefore environmental factor identification and evaluation is the core of the establishment of environmental management system[3].

Identification of environmental factors should follow principles :(1) The Comprehensive Principle of Environmental Factors Identification. Identify the environmental factors of organization's activities and services provision, these factors are able to control and influence (2) The Specificity Principle of Environmental Factors Identification. Environmental factors should be

refined to be checked and verified traceability. (3) The Clarity Principle of Environmental Factors Identification. Identifying environmental factors should clear advantageous and adverse impact. (4) The Description Accuracy Principle of Environmental Factors Identification. Environmental factors may be described as a combination of pollutants name and an action.

There are many ways to identify environmental factors, such as process analysis, production cycle analysis of products, process flow material balance method, questionnaire survey, expert evaluation, site observation, To get objective and reasonable results, company should choose one or a combination of several methods base on the complexity of environment factors. Through site observation, process analysis and statistical methods, identify the factors and impact existing in process segment from input to output. Finally, summarize the same environmental impact or environmental factors having similar control method and make environmental factors summary table.

Environmental factor evaluation methods have judging right or wrong method, expert evaluation method, multi-factor score method, emission/frequency comparison method, equal-standard pollution load method, weighting method, etc. Among them, multi-factor evaluation is more commonly used method, the specific evaluation aspects are shown in Table 1.

Table 1 Scoring criteria for environmental factor evaluation

May score	The frequency of environmental impact (A)	Scope of environmental impact (B)	Recoverability or sustainability of environmental impacts (C)	the situation of compliance with laws and regulations	stakeholders concern (D)
5	occur continuously to once a day	Nationwide	Irreversible or persistent	Emissions exceed standards.	Social concern
4	Once a day to once a week	Regional	More than half a year can be restored	Emissions slightly higher than the standard.	Regional concerns
3	Once a week to once a month	Regional	One week to half a year can be restored	Emissions meet the standards.	Corporate sexual concerns
2	Once a month to once a year	Corporation	A day to one week can be restored	Emissions close to the standard.	Sectoral concerns
1	More than once a year	Small range of minor damage	One day can be restored	Emissions below standard	Basically not concerned

Any of the following situations is judged as major environmental factors. Such as monitoring indicators exceeded or close to excessive; Environmental factors concerned highly or monitored compulsorily by local government; Substances prohibited by government or law; Environmental factors concerned highly or complained reasonably by stakeholder; Environmental factors identified by company as governance point; Environmental factors not taken effective measures in the past. The score of environmental factor evaluation is

$$X = A * M$$

M is the maximum of B, C and D, When X beyond to 20, the environmental factor is judged as important environmental factor and regarded as the environmental management point.

The identification of bottled water enterprise's environmental factor about administrative offices, laboratories and treasury's is the same as other enterprises. The article mainly research the identification, evaluation and control of environmental factors, and apply process analysis method, supplemented by other methods to identify and evaluate bottled water business environment factors.

Identification of Environmental Factors in Bottled Water Enterprises

Identification of environmental factors should start from process analysis, and do it one by one. Take a bottled purified water business' production line for example, the identifying process divide the production process into six stages. That's raw water collection, water pretreatment, water desalination, water sterilization, barrel disinfection and filling, water distribution.

Collection of Raw Materials. Raw water is from tap water factory. The water is delivered to workshop by pump and pipe. Water leakages happen in transportation if pipe inter isn't tight or with long time no maintenance. The results of environmental factors identification are shown in Table 2.

Table 2 Identification of Environmental Factors in Raw Material Collection Process

Raw material collection process	input			Output	
	environmental factor	environmental impact	environmental factor	environmental impact	
The use of pumps	The use of electricity	Energy consumption	Noise emissions	Noise Pollution	
Maintenance of the pump	The use of water	Resource consumption	Wastewater generation Waste generation	Contaminated soil Contaminated soil	

Water Pretreatment. Most of particulate impurities and microorganisms are removed. Equipment such as sand filter, sodium ion exchange softener and activated carbon filter are needed, those should be cleaned before using, but also backwashed the other side of the membrane for a certain time. There may be water leakage in abnormal situation. Sodium ion exchange membrane, a polymer material, needs to be replaced regularly and buried. It needs time to be decomposed and can result soil pollution. The results of environmental recognition are shown in Table 3.

Table 3 Environmental factors identification table of pretreatment process

Preprocessing decomposition	input		output		
	environmental factor	environmental impact	environmental factor	environmental impact	
Filter operation	electricity using	Energy consumption	Noise emissions	sound pollution	
Filter maintenance	membranes using	Resource consumption	Membrane replacement waste generation	waste	Contaminated soil

Water Desalination. After the pretreatment, the organic precipitate, large particle impurity, part of the microorganism and the harmful gas are removed, but the soluble substance still exists. The purpose of desalination is to remove salt. Desalination equipment has permeator, pump, voltage regulator and the control filter. The environmental recognition results are shown in Table 4.

Table 4 Environmental factors identification table for desalting process

Desalination process decomposition	input		output		
	environmental factor	environmental impact	environmental factor	environmental impact	
Equipment operation	water using	Resource consumption	Concentrated water discharge	Contaminated soil	
	membranes using	Resource consumption	Backwashing Wastewater Membrane replacement waste generation	Contaminated soil Contaminated soil	

Water Sterilization. The disinfection of barreled pure water adopts the ozone disinfection and use ozone generator and pump. There may be ozone leakage resulting air pollution in abnormal circumstances. The results of environmental recognition are shown in Table 5.

Table 5 Identification of environmental factors in sterilization process

Sterilization process decomposition	input		output	
	environmental factor	environmental impact	environmental factor	environmental impact
The use of ozone generators	The use of electricity	Energy consumption	Noise emissions Ozone leakage	Noise Pollution Air Pollution
The use of pumps	The use of electricity	Energy consumption	Noise emissions	Noise Pollution

Barrel Disinfection and Filling. The process firstly cleans the outer manually then fill purified water in the disinfection filling machine. Disinfection filling machine may emerge chlorine dioxide leakage in abnormal situation. When the water pipes aren't strict, it may lead to water wasting. The barrel should be removed before cleaning, and discharge discarded lid. The final bottled water is stored in storehouse. The results of environmental factors identification are shown in Table 6.

Table 6 Identification of Environmental Factors in Cleaning, Disinfection and Filling Processes

Cleaning, disinfection and filling process	Input		output	
	environmental factor	environmental impact	environmental factor	environmental impact
Barrel cleaning	The use of cleaning agents	Resource consumption	Waste liquid produced	Contaminated soil
The use of equipment	The use of packaging materials	Resource consumption	The packaging material results in solid waste	Waste of resources

Water Distribution. If pure water only radiates to surroundings, the main vehicle is car. There be vehicle damage in emergency traffic accidents, water leakage. The results of environmental factors identification are shown in Table 7.

Table 7 Distribution process environmental factor identification table

Distribution process decomposition	input		output	
	environmental factor	environmental impact	environmental factor	Environmental impact
The use of means of transport	The use of gasoline	Energy consumption	Exhaust gas emissions	Air Pollution
	The use of cars	Resource consumption	Noise emissions The damage of the cars	Sound pollution Resource consumption

The Evaluation of Bottled Water Companies Environmental Factors

Summarize the environmental factors involved in processes. In the preliminary investigation, site survey method was used to inspect the sewage disposal point, factory's environment, the operation status of equipment, the tightness of pipeline and the solid waste disposal; Through the interrogation method and talking to the workshop staff, ask the operation method and the flow and observe the normative of operation, ask local residents about the degree of concern and complaints of enterprise, whether there is odor, solid waste, noise pollution affecting their lives; Ask the person in charge of production department the enterprise's power and water consumption, the proportion of purified water and raw water consumption, Score and evaluate environmental factors according to the survey and with reference to Table 1, the results of the evaluation are shown in Table 8.

Table 8 Evaluation of Environmental Factors

Activities / services	Environmental factor	A	B	C	D	X	Tense/ state	results
1 raw water collection; water pretreatment; water desalination; water sterilization; barrel disinfection and filling	electricity, water using in the operation of Equipment (pumps, filling machines, filters)	5	1	1	1	5	now/normal	general
	Noise emissions from equipment operation(Pumps, filling machines, filters)	5	2	1	2	10	now/normal	general
2 raw water collection; water pretreatment; water desalination; water sterilization; water distribution.	The use of water in equipment maintenance	3	1	2	2	6	future/normal	general
	The production of wastewater in equipment maintenance	3	3	2	2	6	future/normal	general
3 raw water collection; water pretreatment; water desalination	Water leakage during water transport	3	1	2	3	9	future/abnormal	general
	Pipeline replacement waste	3	1	2	2	6	future/normal	general
4 water pretreatment;	Wastewater generation	5	3	3	3	15	now/ normal	general
	Membrane replacement waste	1	4	4	4	4	future/ normal	general
5 water desalination	Wastewater generation	5	3	4	2	20	now/ normal	important
	waste generation	1	4	4	4	4	future/normal	general
	Ozone leakage	2	2	1	3	6	future/abnormal	general
	Water leakage	3	1	2	2	6	future/abnormal	general
6 barrel disinfection and filling,	Wastewater, waste discharge	5	1	2	3	15	now/ normal	general
	Solid waste generation	5	3	5	3	25	now / normal	important
	Chlorine dioxide leakage	2	1	2	2	4	future/abnormal	general
7 water distribution.	Exhaust emissions	5	4	4	4	20	now/ normal	important
	Pure water leakage	2	1	1	3	3	future / urgent	general
	Accidental damage to the car	2	3	2	3	6	future / urgent	general
	Solid waste generation	3	3	5	3	15	future/ normal	general

Note: Environmental factors with an X value greater than 20 are important environmental factors.

Conclusions

We can formulate targeted management programs reducing environmental impact and improve environmental performance through the identification and evaluation of environmental factors. The core and foundation of system is the evaluation and identification of important environmental and organization environmental factors. And it forward to the control requirements and the goals to be achieved about the important environmental factors. Environmental management system elements carry out activities based on this. In this paper, we focus on the identification of environmental factors and evaluate the key environmental factors in order to provide a scientific method developing targeted environmental management programs. Finally improve environmental performance and continuously improve the level of enterprise environmental management.

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