

Identification and classification of solid waste produced by oil drilling company temporary camps based on RCRA Act and UNEP guidelines and their reuse and disposal management

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Abstract

Introduction: If solid wastes are not collected and disposed properly, can cause environmental pollution which affect human health, animals and plants. Also aesthetic aspect of solid waste disposal is important. Therefore proper management is necessary. This study was carried out for the Identification and classification of solid waste produced by oil drilling company temporary camps based on RCRA Act and UNEP guidelines.

Methods and Materials: Tools used to collect data were a questionnaire and an interview with HSE officials of the company. Also samples were collected from solid waste containers of the camps and analyzed for physical characteristics. Then the obtained data were analyzed statistically by EXCEL and Spss software's.

Results: Results of weight percent of solid wastes were as follows: 77% biodegradable waste, 6% paper and carton, 6% pet, 3% textile, 2% glass, 2% metals, 1.5% plastic, 1% wood, 1.5 % Household Hazardous Waste (HHW) and about 0.5% hospital waste. There was a direct and statistically significant relationship between numbers of employees in temporary camps and amount of solid waste generated per capita ($p < 0.05$). Also the relationship between waste separations within the camps and discharge frequency of pet, plastic and metal was direct and statistically significant ($p < 0.05$).

According to the results, total amount of solid wastes generated in 31 camps were 2801 kg at day, Wastes Density of solid wastes was $433 \frac{\text{kg}}{\text{m}^3}$ and per capita solid waste generation was $0.87 \frac{\text{kg}}{\text{day}}$.

Conclusions: We can conclude that solid waste of oil drilling company temporary camps is similar to municipal solid waste and that dry wastes can be recycled and food wastes can be used for composting.

Keywords: solid waste, temporary camps, oil drilling, management.

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► Please cite this paper as:

Hataminejad MR, AK Neisi, Farrokhan F.. Identification and classification of solid waste produced by oil drilling company temporary camps based on RCRA Act and UNEP guidelines and their reuse and disposal management. Jundishapur J Health Sci 2013;5(3):157-166

Received: 2013/4/30

Revised: 2013/7/13

Accepted: 2013/7/14

Introduction

Despite researches carried out on waste management of oil and gas wells drilling operations around the world, there is no comprehensive study on management of solid wastes from human activities in National Drilling Company temporary camps particularly their compliance with national and international regulations. Some studies have just pointed to specific parts of the waste generated (3, 5, 11, 13). Several studies have been done in the fields of waste disposal and waste management, including:

Anbia and et al 2006: The identification and classification of wastes from oil and gas drilling wells. They were divided into two groups: normal waste (natural) such as drilling logs and industrial wastes such as drilling fluids, also to reduce the negative environmental effects, they proposed three strategies: 1- waste minimization 2-recycle and reuse 3-disposal (3).

Abdolkhani and et al 2010: By examining the types of drilling mud such as water-based emulsion mud and oil based mud, used in drilling oil and gas wells, referring to the most important pollutants of drilling mud such as: Gasoline, saturated brine, drilling starch, polymers, different materials of drilling mud and etc. Introduced a new method to reduce emissions and recycling of drilling fluids (5).

Sabur and et al 2008: The physical properties of the solid waste generated in the oil regions to provide proper disposal options examined. They described the goals of their research as follows: 1- Determine the size, capacity and facilities that required waste management system 2- Determine the potential for recycling or composting 3- Programs that reduced the amount of waste produced 4- Determine the potential environmental

pollution caused by waste. The sources of waste in studied area were classified into four categories: 1- Municipal waste 2- Hospital waste 3- Industrial waste 4- Special waste. According to the results of physical analysis of waste, their solutions were offered as options for disposal:

- Composting organic waste from food waste (perishables)
- Teaching staff separation of wet and dry waste generated from the source
- Separating recyclable waste such as: pet, carton, plastic, paper, ferrous metals and non-ferrous
- Construction of leachate collection and treatment facilities near waste disposal facilities
- Construction of incinerators for capable combustion waste (11).

Ravishankar et al. in 2008 carried out a study in remote area of oil fields for solid waste management. Results showed that there was no contractor for collection and disposal of solid waste; also there was no segregation of hazardous and non-hazardous generated solid waste: they concluded that because of the sensitive ecosystem, especially underground water, it is necessary to collect and dispose solid waste correctly (13).

To provide appropriate management model for the reuse or disposal, it is necessary to research and fully recognize the waste generation process, waste types including biodegradable or non-biodegradable, their quantity and quality and meeting environmental regulations (14, 15, 16, 17).

In the first step of Oil Drilling Operations, National Iranian Drilling Company built up a temporary settlement camps, resting and feeding their operational staff. During the drilling operations period solid wastes

were generated from drilling operations and human activities. Generation process, collection and disposal of solid waste can affect human health and environment. First step for proper management of generated waste is quantity and quality of identifying them (12).

From a total of 41 camps of oil drilling national company in Khuzestan province, 31 temporary camps were selected to carry out the study and show their compliance with UNEP and RCRA solid waste regulations (14, 15, 16). Because there was no study about solid waste collection and disposal of oil drilling temporary camps, it was necessary to identify quality and quantity of oil drilling temporary camps waste, Classify and propose proper management and methods of disposal.

Methods and Materials

Due to the excessive size and dispersion of drilling activity and oil production sites in Iran, in this research it was decided to focus on oil drilling sites located in Khuzestan province. Since temporary camps are dispersed around Khuzestan province, 31 camps were selected from among the total of 41 active sites. Khuzestan province is the most important province from point of view in oil production.

At starting stage, researchers coordinated with the Department of Health, Safety and Environment (HSE) of National oil Drilling Company, oil drilling company officials and employees. To understand environmental pollution caused by different phases from Oil fields activities and drilling operations particularly solid waste generation, the following three general steps have been put forward in this study:

Step one: Literature review of evidence and information collected and environmental assessment documents,

technical reports, related papers and dissertations.

Second step: the next step, preparing and distributing questionnaires designed by experts to identify waste generation process in 31 active drilling sites in the Khuzestan province. The Questionnaire included 30 questions which was divided into 9 domains. These domains were: 1. Location and situation of temporary camps 2. Type and rate of material consumption 3. Solid waste generation rate 4. Types of generated wastes and percentages of its constituents 5. Collection, reservation, and transportation 6. Solid waste disposal methods 7. Physical characteristics of solid waste 8. Solid waste constituents 9. Solid waste recycling. Also field visited to observe waste generation, collection, and disposal.

Third step: Sampling and physical analysis of solid wastes collected in containers of 31 camps were performed. In each camp 3 container were randomly selected, then solid waste density was determined, after that each component was separated to determine weight percentage of solid waste.

Results

Based on results of questionnaires and visits to camps:

Diet programs of personnel lived in the camps were offered at all temporary camps of National Drilling Company was same.

Composition and type of materials and components of waste generated was also the same. Accordingly, components of produced wastes were heterogeneous mixture of two types, Biodegradable waste and dry wastes.

Dry wastes were as following:

1- Paper and Carton 2- pet 3- Textiles 4- Glass 5- Metals 6- Plastic 7- Wood 8- Household Hazardous Waste (HHW)

According to the results, total amount of solid wastes generated in 31 camps were 2801 kg at day.

Solid waste generation rate per capita was 0/87 kg and the overall density was 433 kg/m³.

It should be noted that negligible amount (about 0.5%) of hospital waste was generated from clinic caravan located near to Rig. These hospital wastes were collected and disposed separately from other solid wastes.

Figure 1 show the composition and constituents of waste generated in the temporary camps of 31 and their weight percentage. As it is shown most of solid wastes (77%) are compostable and the rest are recyclable (21.5%), Household Hazardous Waste (HHW) were 1.5%.

Figure 2 shows that the main sources of waste generation of total waste generated were 87 percent biodegradable wastes such as food, vegetables and fruits from kitchen and dining hall located near camps and Rig caravan. 10 percent normal waste was generated by employees' caravans, 3 percent from operation equipment in camps near drilling Rig such as power generator engine.

Figure 3 shows the weight percentage and types of waste generated in

temporary camps based on hazardous nature, 98% of them were normal waste (non-hazardous), 1.5 percentage related to household hazardous waste (HHW) and hospital waste were only 0.5%.

In 87 percent of the camps, solid waste was dumped in open area without appropriate cover and burned. Only 13 percent of the camps in Azadegan oil-based sites have relatively acceptable temporary storages. Figure 4 shows the percentage of temporary storage methods in 13 percent of the camps. 67/2% in a determined area (without a proper cover), 24/9 percent in the plastic bag or box and 7/9 percent kept in 220 liter barrels.

From total waste, 77 percent were compostable and 23% were non-compostable. Compostable waste includes residual food, vegetable and fruits. Non-compostable waste that were recyclable 17.5% included paper and carton 6%, pet 6%, glass 2%, metals 2% and plastic 1/5%.

Authorities responsible for transportation and final waste disposal were mainly by camp authority itself. Truck was used for transportation. These trucks belonged to the Oil drilling company. In Azadegan oil field camp, a private contractor transported and disposed solid waste.

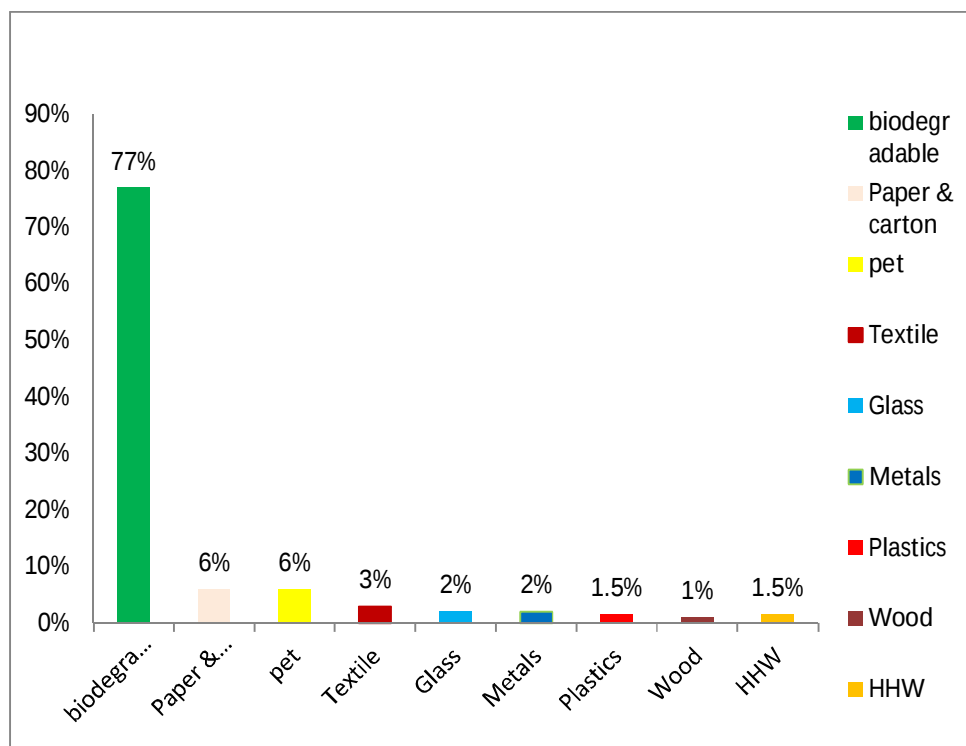


Figure 1: Weight percentage of solid waste components

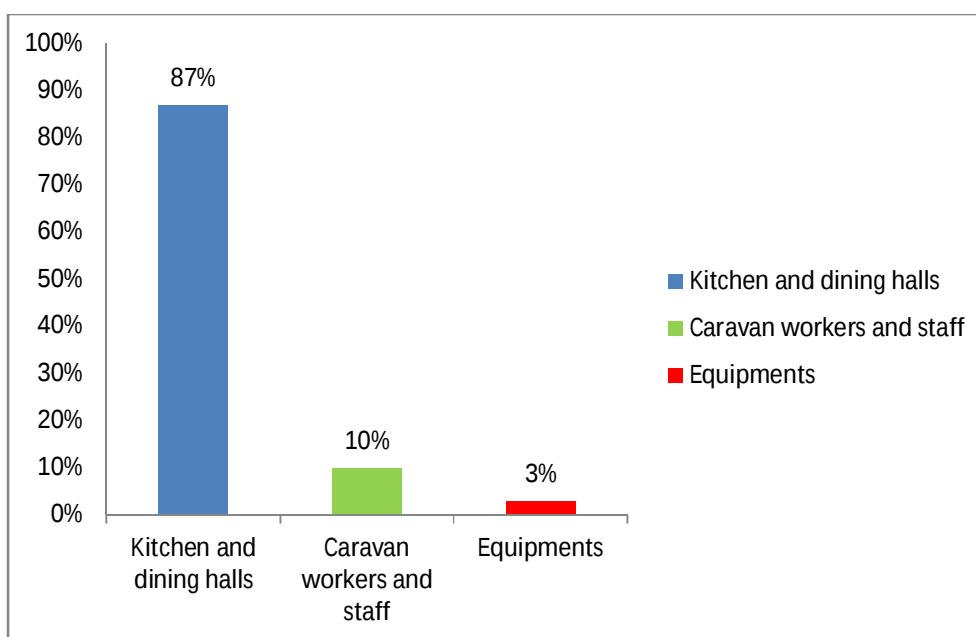


Figure2: Main Sources of Solid waste generation

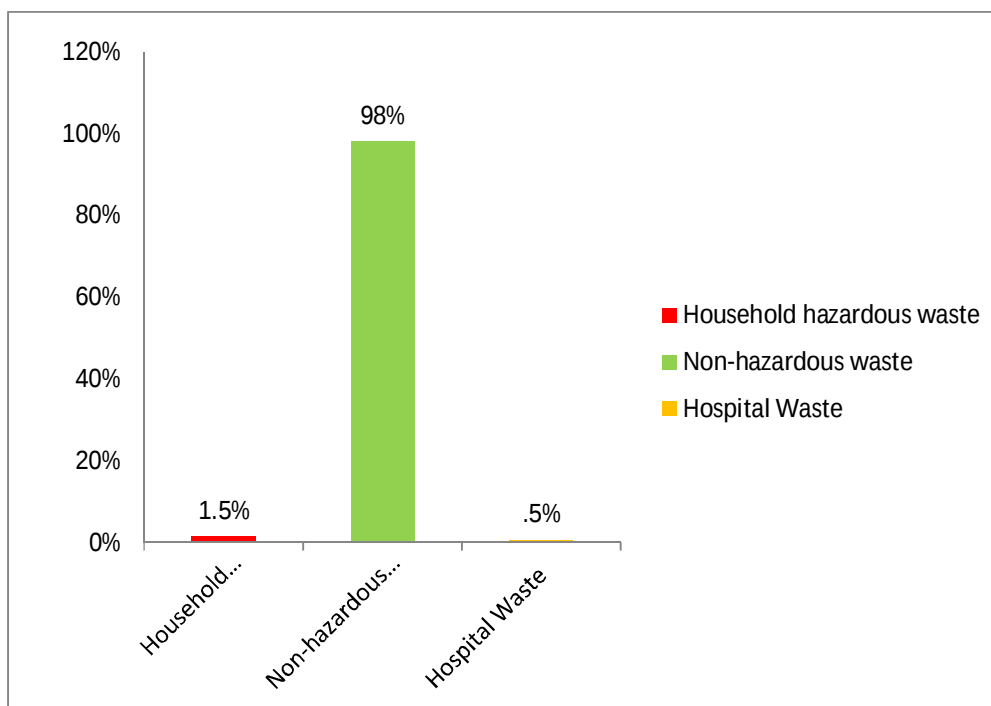


Figure 3: Solid waste type percentage

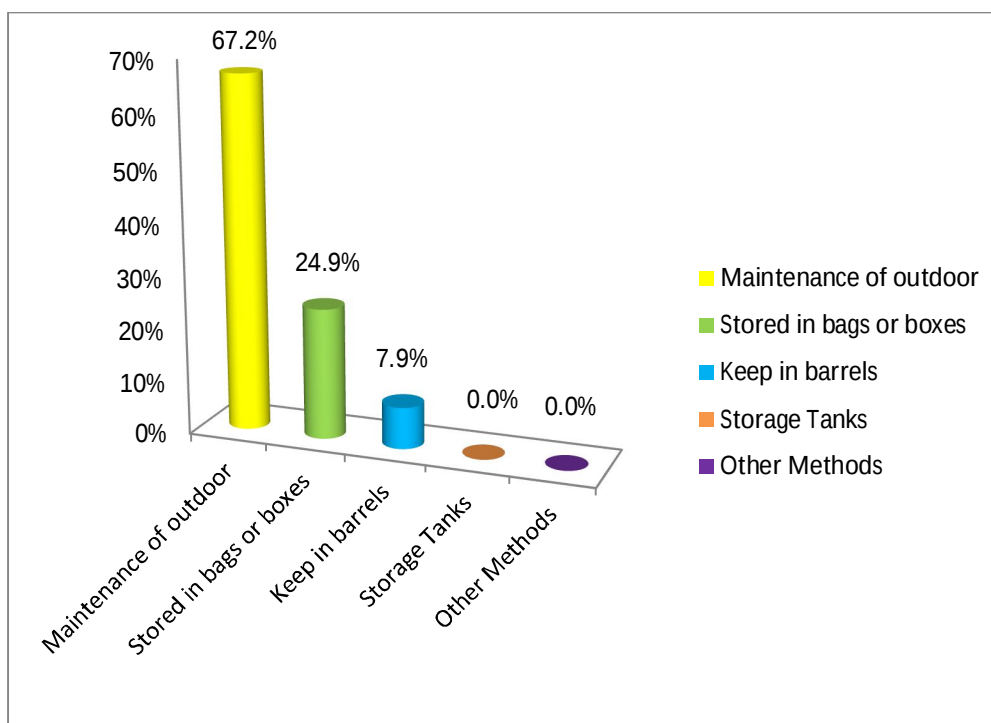


Figure 4: Solid waste temporary storage methods

Table 1. Pearson correlation Coefficients and P-values of some variables

	Personnel Pearson Coefficient P-Value	Segregation inside the camp Pearson P-Value Coefficient	Healthy Segregation Pearson Coefficient P-Value
Solid waste generation	.79 .000		
Glass disposal	-.42.02		
Food disposal		.59 .001	
Metal disposal		.62 .000	
Plastic disposal		.79 .000	
Cloth disposal		.59 .001	
wood disposal		.6 .000	
Pet disposal		.8 .000	
paper disposal		.59 .001	
discharge frequency for PET			.44 .01
discharge frequency for plastic			.38 .04
discharge frequency for metals			.38 .04

Discussion

In order to show the statistical relationship between variables studied in this research, Pearson correlation coefficient was calculated. Pearson correlation coefficients and the P-Values are shown in table 1. As it is presented:

There was a direct and statistically significant relationship between numbers of employees in temporary camps and the amount of solid waste generated per capita; this means that by increasing the number of employees, waste production is also increasing in the camps.

There was a reverse and statistically significant relationship between numbers of employees in temporary camps and glass disposal, this means that by increasing the number of personnel, glass disposal decreased, this is possible because recycling glass in camps have more employees.

The relationship between waste separations within the camps and discharge frequency of pet, plastic and metal was direct and statistically significant; this means that by increasing solid waste component separation, discharge frequency of pet, plastic and metal inside camps increased, maybe because when frequency gets more, its need to discharge gets faster.

The relationship between components of solid wastes such as residual food, pet, plastic, metal, wood, paper and cloth, and final disposal method was direct and statistically significant. This means that by increasing components separation within the camps, final disposal methods such as incineration or recycling performed more.

The relationship between safe and sanitary separation and discharge frequency of pet, plastic and metal was direct and statistically significant; this means that the compliance with health

and safety aspects, and the discharge of these components also increased.

Variety of materials were used at oil drilling sites and temporary camps including industrial, Non-industrial and chemical types, hazardous and non-hazardous(6). So by consuming these materials, solid waste wastes were generated and collected by trash bins. When these solid wastes were collected in temporary storage places, were mixed with other wastes. This was due to lack of awareness among workers about health and environmental adverse effects of solid wastes (9). Unfortunately, in 87% of camps, authorities dumped solid waste without proper cover in open areas due to neglect about health issues and environmental hazards of solid waste. This can cause nauseous odors, causing leachate, and increase in dangerous vermin or insects.

All of the above issues should be seriously considered, plus considering the extent and distribution of oil and gas companies operating across the country. There are Aquatic, marine, terrestrial environments or wetlands (e.g. Hoorolazim, Hoveyzeh) and even protected areas (such as Azadegan area and central desert of Iran) that oil drilling company is working there. Considering the vast range of industrial pollutants in different stages and phases of oil exploration, drilling, and extraction, the importance and necessity of proper waste management and comply with environmental laws and regulations will be revealed (7).

According to guidelines outlined in international and domestic environmental regulations in hazardous and non-hazardous wastes management, each of them must be first identified, then separated, then collected, temporary stored and finally disposed (8, 9). Despite this emphasis, none

of these steps were properly performed. According to RCRA (Resource Conservation and Recovery Act) definition about household hazardous waste (HHW), part of camps generated waste, can be classified as household hazardous wastes, since household hazardous waste contains features such as toxic, corrosive, flammable, explosive properties. Also because of the refractory and bio-accumulation of such wastes they are harmful to human health. These components are classified in subgroup C (hazardous waste) of RCRA (15). Therefore, improper management, especially in final disposal, can have long-term environmental and health risks and hazardous potential for human health and environmental elements alive and living in the environment, such as water, soil, animals and plants (10).

It is important to mention that most of the camps are located outside or inside urban environment, close to agricultural land areas, near aquatic environments where humans, birds, fishes and even livestock travel or live, near rivers, protected areas and so on. The most important point is that each of these mentioned areas have critical role in food chain, and production; including farming, animal husbandry and fishery. Moreover, currently there is no waste management for HHW. They were collected and disposed along with normal (household) solid wastes. This is totally contrary to environmental recommendations; particularly RCRA Hazardous Waste Management.

According to RCRA, other wastes such as food, paper, pet, textiles, glass, metals, plastics and wood that have the highest value, are mainly classified in subgroup D (non-hazardous waste) (14). Adapting UNEP (United Nations Environment Program) recommendations about solid waste, Basel hazardous waste classification, types and components of waste generated in

temporary camps, can be adopted with code Y46 and can ash of burning wastes with Y47 code (16). It should be noted that based on hazardous waste Basel convention, there are no cods for household hazardous wastes; but they need special attention. Based on waste Management Act of Iran, non-hazardous waste components (same household) of temporary camps are considered as ordinary waste, and household hazardous waste components are considered as special waste. According to an article number 1 of Iran waste management act, emphasize on special management of these wastes. Article number 7 of Iran waste management act recognizes waste producers that are responsible for solid waste management. According to articles 15 and 18, producers are responsible for optimization, recovery, and minimization of generated solid wastes and also waste disposal in a way that cannot lead to contamination and risk to humans and the environment (17).

Polluters must immediately take measures to control environmental pollution and immediately stop their activities to remove contamination and clean environment (17). According to legal materials of Iran waste management act, current methods used for collection, temporary storage and final disposal, especially hazardous waste produced in oil drilling company temporary camps is not legal.

By comparing the results of this study and the study carried out in Esfahan Industrial zone by Ahmadi and colleagues in 2009, this study was more comprehensive.(1)

The current study adopted solid waste management process in the camps with UNEP (Basel Convention) and Iran Waste Management Act, this is an advantage compared to Basym & colleagues study in 2010 entitled" quantity and quality of industrial and non-industrial solid waste of

oil and gas operating company in Aghajari Khuzestan, Iran" (2). Our results are consistent with the study of Krish Ravishankar and colleagues in 2008 entitled "A desert waste management in Yemen," which studied oil field camps in Yemen deserts (13).

One of the more useful studies done by Garfi and colleagues in 2009, was entitled "Multi-criteria analysis to decision-making on waste management methods in Saharawi refugee camps (Algeria)", which used a new method to decide about waste management alternatives', but in contrast to the current study, its weakness was that they had not considered international or national regulations(4).

The authors would recommend researchers to study solid waste situation in oil drilling camps in other parts of Iran in different seasons.

Conclusions

1- We can conclude that solid waste of oil Drilling Company camps are similar to municipal solid waste in composition.

2- Results showed that the generated waste in the National Drilling Company employees' camps was recycled and composted primarily because of the conversion capabilities. Household hazardous waste (HHW) is about 1.5 percent of the total waste and also about 0.5% of hospital waste is generated that can be separately collected and disposed.

3- Based on results of this study, solid waste process management in 31 temporary camps of oil drilling company from collection, segregation, storage, transport, and especially final disposal are not favorable to comply with regulations and recommendations of international such as UNEP, RCRA and internal (Iran) environmental rules and regulations.

References

- 1-Ahmadi S , MierGhafari N , Ghodosi H , AL Kathiri H . [Assess the status of the household waste

management in Razi Esfahan Industrial Park]. Proceedings of the 5th National Conference on Waste Management; 2011; Mashhad , Iran. [In Persian]

2-Basim Y, Tayebi Kh, Abolhasani E. [Industrial and Non-industrial waste quantity and quality of oil and gas companies operating of Aghajeri]. Proceedings of the 1st Conference on wastewater and solid waste management in the oil and energy industries; 2010 Day (January) 1& 2; Tehran , Iran. [In Persian]

3-Anbia M, Ataii A, Sepehriyan H, Garshasbi V.[Methods for managing the detention of drilling oil wells in the south in order to reduce the negative environmental impacts of the oil regions of southern]. Proceedings of the 1st National Conference on Safety Engineering and HSE Management; 2006 Esfand (March) 11-9; Tehran, Iran.[In Persian]

4-Garfi M; Tondelli S; Bonoli A. Multi-criteria decision analysis for waste management in Saharawi refugee camps., Waste Management; 2009 29,2729–2739.

5-Abdolkhani A, kariminasab H, Gharebygi A. [Processes injury prevention environmental management of drilling waste]. Proceedings of the 1st Conference on wastewater and solid waste management in the oil and energy industries; 2010 Day (January) 1& 2; Tehran, Iran.[In Persian]

6-Abdolkhani A, Moazeni A, Ghadami jegerloei S, Azizi R , [Mitigation of environmental pollution and waste management in the oil and gas wells]. Proceedings of the National Conference on Energy and Environment; 2010 Mehr(October) 28-29 ; Kerman ; Iran. [In Persian]

7-Tchobanoglous G; Kerith J. Practical Guide to Waste Management. Municipalities and rural organization, ministry of internal affairs, Iran; 2008.[In Persian]

8-Habibi nejad M.[Practical Guide to Industrial Waste Management]. Tehran; Avam Publisher; 2011 .[In Persian]

9-Talebi K. [Waste management to reduce the harmful environmental effects of drilling].

Proceedings of the 2nd Specialty Conference on Environmental Engineering; 2009 Ordibehesht(May) 28-Khordad (June) 1; Tehran, Iran. [In Persian]

10-Takdastan A, Seraj M , Alavi N A, Jafarzade N .[Good model for organizing waste management, hazardous waste management in urban of Iran (A case study in Ahvaz)]. Proceedings of the 6th National Conference and the 1st International Conference on Waste Management; 2012; mashhad , Iran. [In Persian]

11-Sabur M, Pouraghdam S; Ghanbarzadeh lak M.[Physical properties of solid waste in the oil regions of southern]. Proceedings of the Specialty Conference on Oil, Gas and the Environment; 2008 Aban(November) ;Shiraz ,Iran. [In Persian]

12-Fanavaran Absazeh Consulting Engineers Firm., Baseline studies and environmental assessments of North Azadegan oil field; 2008; Report No.1. [In Persian]

13-Ravishankar K, Thurber MW, Brower RA, McClurg J. Waste Management in a Desert Environment, Yemen. Proceedings of the SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production; 2008 Apr 15-17; Nice, France.

14-USA-EPA, Solid Waste, Available From: WWW.USA-EPA.GOV/ RCRA, Solid Waste, 40 CFR, parts 240 to 258. Accessed 2012 September

15-USA-EPA, Hazardous Waste, Available From: WWW.USA-EPA.GOV/ RCRA, Hazardous Waste, 40 CFR, parts 260 to 282. Accessed 2012 September.

16-Unep, Bazel Convention, 1989, Available From: Www.Unep.Org/Bazel Convention On: The Control Of Transboundary Movements Of Hazardous Wastes Andtheir Disposal,. Accessed 2012 September.

17-DOE, Waste Management Act, 2004,Available From: www.doe.ir (Environmental Protection Organization of Iran) / Waste Management Act, Accessed 2012 September.