Sludge quality in wastewater treatment plant in Shokohieh industrial Park of Qom province in Iran

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ABSTRACT

The general attitude of the wastewater treatment process in our country is focus on the effluent quality and unfortunately waste sludge quality is rarely considered. Since multiple natural hazards and routes the contact with sludge requires a comprehensive approach to protect public health and the environment. The aim of this study is an assessment of sludge management and finding out the potential use of sludge for land application. The study was conducted in January to December 2014. samples were gathered in four seasons, winter, spring, summer and autumn from wastewater treatment plant in industrial park of Shokohieh of Qom province according to the instructions in standard method. Sampling was moments and composite. Numbers of Samples were 24 that 2 samples were captured in every month. Samples measured base on standard method for water wastewater examination references and then data was analyzed by SPSS and t-test. The results show that the Physical Parameters qualities and nutrients qualities in sludge are good. The Phosphate quality is not suitable. Based on t-test, the results show that levels of fecal coliform and total coliform in cold and warm seasons are different ($P < 0.001$). This study showed that sludge ranked in Class B (EPA standard). The results of this study indicate that relationship between levels of parasite eggs and fecal coliforms is the best (pearson coefficient=0.995). The correlation coefficient levels of parasite eggs and total coliforms are 0.969. The mean values of elements are upper than the EPA standards, except lead, arsenic, mercury, cadmium and zinc. This study shows that sludge ranked in Class B therefore is not suitable for various uses of sludge as: grass, playgrounds, for other uses, such as farmland and forest. Sludge has high levels of toxic metals, which are inapplicable due to the accumulative property.

Key words: Industrial, Quality, Sludge, Treatment, Shokohieh, Qom, Iran

INTRODUCTION

Sewage sludge is residual from wastewater treatment, In fact, an important byproduct of the refining process [1]. The general attitude of the wastewater treatment process in our country is focus on the effluent quality and unfortunately waste sludge quality is rarely considered. Since multiple natural hazards and routes the contact with sludge requires a comprehensive approach to protect public health and the environment, so any management plans and rules are important for use or disposal of sewage sludge [2]. The aim of the treatment sludge is alteration raw sludge into inert substances [3]. Methods that are used for sludge treatment depends on the size, type and location of the plant, operation in units, the solid characteristics and finally the method of final disposal of sludge [1]. volume of dry sludge is high. The solids produced in the wastewater are 85 g for person per day [4]. Sludge used in agriculture, forestry, turf, playgrounds and recreation sites, fertilizer, land reclamation, etc. Each of the above methods has advantages and disadvantages. The main advantage is the presence of nutrients required by plants, having the value modifier for soils, having low cost, no heavy metal limits for non-agricultural purposes, and adjusted pH level soil to neutral [5]. Improper disposal of sludge that contains pathogens caused for spreading communicable diseases through

consumption of contaminated crops or human contact with the soil [6, 7]. Using from this sludge can be dangerous potentially for crops, animals and humans because people contact with lawns [8]. Hospido reported, digested sludge to be used on agricultural land [9]. Elvira determined that the use of sludge for production vermicomposting increase phosphorus concentration in compost [10]. In recent years, detergents, turbidity and organic matter from wastewater and sludge are one of the main and vital threat for the source of drinking water, agriculture and industrial uses in Iran that threaten human health [1,2,7]. In any case, characteristics of sludge must be defined to ensure pollutants before than consumption. The main problem of raw sewage sludge generated in a sewage treatment plant are high volume, potential odor nuisance, the weight of organic matter and there are so many types of pathogenic microbes and parasites [7-10]. Shokohieh industrial Park is one of the industrial estates in the city of Qom that including numerous industries food, metal, textile and chemical. The purpose of a management plan is the find an appropriate method of sludge disposal and beneficial application. By using the management methods can also be reduced sludge production and use of sludge was utilitarian and non-utilitarian. The feasibility of reusing sewage sludge had been done in the sludge of the plant. In this study the quality of wastewater treatment plant in Shokohieh industrial Park is assessed for management sludge and finding out the potential use of sludge for land application.

MATERIALS AND METHODS

An experimental study was conducted in the chemical laboratory of Qom University of Medical Sciences of Iran. In this study, were sampled of sludge in wastewater treatment plant in industrial park of Shokohieh of Qom province. This sludge is dried sludge (sludge drying bed.) Sampling was performed according to instructions in standard method. Sampling was moments and composite. The effects of pollution were investigated on the sludge in wastewater treatment effluent samples. The study was conducted in January to December 2014. Samples measured by standard method for wastewater (Standard methods for the examination of water and waste water.2005) [11]. The region's climate is with warm summers and cool winters and dry therefore the sludge samples were gathered in four seasons, winter, spring, summer and autumn. In this study, physical parameters, chemical parameters and biological parameters of sludge was determined as an indicator of quality. Numbers of Samples were 24 that 2 samples were captured in every month. In the present study the location of sludge sampled were collected from the seabed sludge dehydration (sludge process dryer) and the pump discharge. The all of material used in this study make by Merk Company. The results are analyzed by SPSS and t-test. The means of results were compared with the national and international standard values.

RESULTS AND DISCUSSION

Table 1 provides the results of physicochemical sludge that indicated the mean pH, moisture, sodium, potassium, carbon, nitrogen, C/N ratio and phosphate sludge treatment plant, compared with the typical values.

Relationship between parasites eggs and Fecal and Total Coliform

The Figs. 1 and 2 indicate that the relationship between levels of parasite eggs and fecal coliforms. The results of this study indicate that relationship between levels of parasite eggs and fecal coliforms is the best (Pearson coefficient = 0.995). The correlation coefficient levels of parasite eggs and total coliforms are 0.969.

Levels of fecal coliform, total coliform, salmonella and parasites eggs show in Table 2.

The most important measures of sludge are heavy metals that results are presented in Table 3.

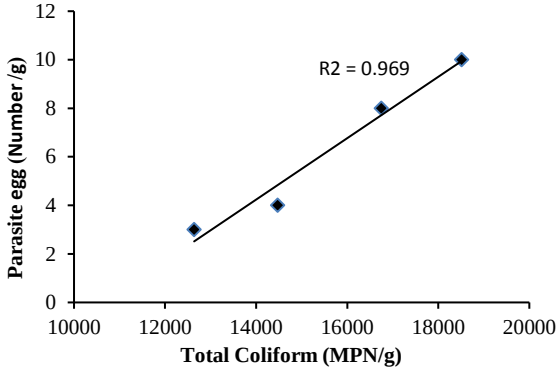

Fig. 1: Relationship between Parasite eggs and Total coliforms

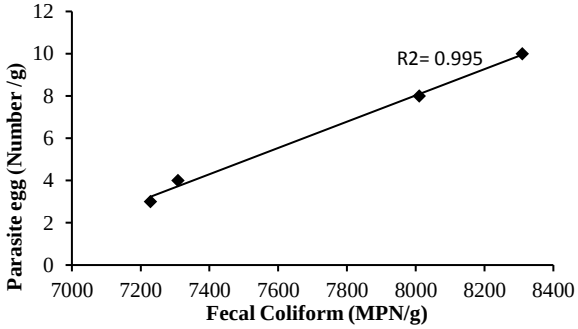

Fig. 2: Relationship between Parasite eggs and fecal coliforms

Table 1: Physical parameters and fertilizer value of sludge and compared with normal values

Physical Parameters	Season	Mean	Std. Deviation	EPA Standard
pH	Spring	7.21	0.098	6-9
	Summer	7.27	0.215	
	Autumn	7.15	0.03	
	Winter	7.06	0.025	
Sodium. %	Spring	0.40	0.017	0.2-0.5
	Summer	0.41	0.012	
	Autumn	0.4	0.01	
	Winter	0.39	0.015	
Potassium. %	Spring	0.11	0.005	0.1-2.8
	Summer	0.11	0.005	
	Autumn	0.12	0.001	
	Winter	0.10	0.005	
Wet. %	Spring	31	3.445	30-50
	Summer	28	2.483	
	Autumn	29.29	2.2	
	Winter	38	3.189	
Carbon. %	Spring	7.67	0.292	8-50
	Summer	7.07	0.280	
	Autumn	8.01	0.3	
	Winter	8.18	0.201	
Nitrogen. %	Spring	0.371	0.0147	0.1-3.5
	Summer	0.293	0.0314	
	Autumn	0.41	0.02	
	Winter	0.446	0.0307	
C/N	Spring	19.379	1.943	20
	Summer	21.332	2.337	
	Autumn	19.19	3.6	
	Winter	18.411	1.5199	
Phosphate. %	Spring	0.01	0.001	0.3-3.5
	Summer	0.02	0.001	
	Autumn	0.01	0.001	
	Winter	0.01	0.002	

Table 2: Microbial parameters of sludge and compared with EPA standard

Microbial Parameters	Season	Mean	Std. Deviation	EPA Standard
Total Coliform.MPN/g	Spring	14468	0.817	<1000
	Summer	12638	7.3825	
	Autumn	16750	1.4	
	Winter	18510	1.56	
Fecal Coliform.MPN/g	Spring	7308	0.8165	<1000
	Summer	7228	8.383	
	Autumn	8010	1.5	
	Winter	8310	1.472	
Salmonella.MPN/4g	Spring	60	0.8263	<3
	Summer	56	0.326	
	Autumn	68	0.3	
	Winter	68	1.236	
Parasite eggs. Number/4g	Spring	16	0.8144	<1
	Summer	12	0.356	
	Autumn	32	0.3	
	Winter	40	1.201	

Table 3: concentrations of heavy metals of sludge and compared with Iran standard

Heavy Metals	Season	Mean	Std. Deviation	Iran Standard	P Value
	Spring	5.51833	0.176909		<0.001
	Summer	5.25833	0.280030		<0.001
Cadmium. mg/Kg	Autumn	5.12	0.11	10	<0.001
	Winter	5.43333	0.344480		<0.001
	Spring	1309.833	7.05774		<0.001
	Summer	1418.333	9.9265		<0.001
Chromium. mg/Kg	Autumn	1301.13	10.10	1000	<0.001
	Winter	1281.266	8.14879		<0.001
	Spring	0.178333	0.028577		<0.001
	Summer	0.188333	0.022286		<0.001
Mercury. mg/Kg	Autumn	0.18	0.02	10	<0.001
	Winter	0.188333	0.020412		<0.001
	Spring	0.28333	0.01862		<0.001
	Summer	0.22333	0.0225		<0.001
Arsenic. mg/Kg	Autumn	0.3	0.003	41	<0.001
	Winter	0.35000	0.0447		<0.001
	Spring	108.5000	2.66458		<0.001
	Summer	107.3333	4.36653		<0.001
Lead. mg/Kg	Autumn	109.5	1.5	750	<0.001
	Winter	110.0000	2.82842		<0.001
	Spring	2868.3500	6.21351		<0.001
	Summer	2515.4667	7.0987		<0.001
Copper. mg/Kg	Autumn	2300.25	5.05	1000	<0.001
	Winter	2702.8667	7.10922		<0.001
	Spring	1887.1667	2.55142		<0.001
	Summer	1949.1667	3.73195		<0.001
Zinc. mg/Kg	Autumn	1757.8	6.36	2500	<0.001
	Winter	1700.6667	8.21225		<0.001
	Spring	2869.867	1.3917		<0.001
	Summer	2661.017	3.8270		<0.001
Nickel. mg/Kg	Autumn	2901.29	5.5	300	<0.001
	Winter	2945.517	4.06113		<0.001

The study was conducted on dry sludge in wastewater treatment plant in Shokohieh industrial park. The results show that the Physical Parameters qualities, nutrients qualities are good. Phosphate quality is not suitable. The results showed that pH, sodium and potassium are in standard range. Carbon concentrations in the autumn and winter were in standard range. The moisture levels in summer were not in standard range. Bina evaluated on the quality of the sludge treatment plants that showed pH, moisture, nitrogen, phosphorus and potassium were in accordance with the standard range [3], but the mean values of sodium are inconsistent with results of our study. Abbasi and *et al.* showed that pH values are standard [12] that with present study is in agreement. Based on t-test, the results show that levels of fecal coliform and total coliform in cold and warm seasons are difference ($P<0.001$). Result of this study were similar to study of Takdastan that showed the dried sludge placed in the class B Standard Environmental Protection Agency United States (EPA) CFR 40 Part 503 regulations because they have values greater than 1000 and less than 2×106 (MPN per g of dry solids) [13]. The study of Mesdaghinia and colleagues showed that the sludge was not in any of the standard classes [14]. The study of Farzadkia indicates that characteristics of sludge have significant difference with Class A and B of EPA regulations [15]. The results of this study indicate that relationship between levels of parasite eggs and fecal and total coliforms that is according to the Mir Hosseini study [16]. The results indicate that mean heavy metals are upper than the EPA standards, except lead, arsenic, mercury, cadmium and zinc. Study of Hosseini [17] and *et al.* indicates that the mean cadmium and zinc was less than the standard that is in agreement with the present study. The comparison of results of this study with study of Gautam and *et al.* 2017 showed that zinc and cadmium concentrations in sewage sludge were in standard range [18]. Farzadkia and *et al.* 2005 in own study on study the sludge quality of Serkan wastewater and comparison it with standard levels reported that year average of Vs/Ts and Sour in sludge was 0.73 and 3.37 mg O2/ g.Vs.h. they are also reported that the sludge dye, average of fecal coliform per dry solid and parasite eggs were dark brown, 8.97×107 and 251 [19]. Ghoreishi and *et al.* 2015 in own study with the title of Evaluation of Microbial Quality in Municipal Wastewater Treatment Plants Biosolids Generated from reported that Jolfa was highest contaminated with total coliform 1.82×106 MPN/g and Sarab showed lowest fecal coliform count with 2.02×103 MPN/g. They are

also reported that the sludge from Tabriz wastewater treatment plant was most contaminant sludge with bacteria count equal to 84 per g. in the Ghoreishi study at the conclusion part stated that the stand point of microbial quality, all sludge samples met class B standards set by USEPA, while none of them could provide class a standard [20].

CONCLUSIONS

Sewage sludge in wastewater treatment plant in Shokohieh industrial park can use as a valuable source of nutrients for fertilizer. The result of this study showed that the sludge of Shokohieh wastewater treatment plant located in level of Class B standard base on EPA institution. So the sludge of Shokohieh wastewater treatment plant is not suitable for various uses such as: grass, playgrounds, home garden, pots but to be used for other purposes and surface disposal without limitation. Heavy metals were upper than standard therefore sludge is inapplicable for agricultural. Review is necessary for wastewater treatment process and sludge treatment in wastewater treatment plant in Shokohieh industrial park. This Sludge has fertilizer values and high volume. Using from this Sludge has financially advantage and environmentally advantage.

ETHICAL ISSUES

Ethical issues entirely have been considered by the authors. And desperately tried to avoid plagiarism.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

AUTHORS' CONTRIBUTION

Conception or design of the work and data collection was done by Hamed Hedayati. Drafting the article and critical revision was implemented by Soroush Ghasemi. Gitipour's comments in all stages, specifically on design of the work and also final approval of the paper, were highly helpful.

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