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Treatment of thickened sludge using date pits

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***Abstract*— The sludge often contains high concentrations of toxic elements and heavy metals such as lead and mercury Cadmium and others, which negatively affects the use of sludge produced after dewatering and difficult to benefit from it. It affects the environment and the public health of the human. In this study was disposed of heavy metals using a new material that has a high degree of adsorption as well as it is cheap and easy to obtain. We can eliminate the largest percentage of heavy metals by date pits.**

In the previous paper [1] was used some guidance to select the most suitable flotation technique for sludge dewatering, access to the higher separation of solids at the lowest cost and less operation and maintenance. It was concluded that the experiment was carried out in three stage. In the first case, the best results were obtained when the bubbling pressure was 0.6 kg / cm2. In the second case, the best Alum dose was determined to help the sludge group and float. During the experiment the best dose is 80 mg / L. In the third case, it was concluded that the economic dose of nitrogen gas is 60 mg / L with the separation efficiency of 85%. In this paper thickened sludge is taken after dewatering and injected with a fixed dose of heavy metals (lead Pb and mercury Hg) by 2 mg /L, then we inject the sample with different doses of date pits and measure the remaining heavy metals found. The efficiency of date pits in the removal of heavy metals about 85%. Finally, the results show the feasibility of using date pits for removal of heavy metal from a sewage sludge

Key wards — sludge treatment, wastewater, dewatering, flotation, date pits (DP).

I. INTRODUCTION

The disposal of Sewage Sludge (SS) or its application on farmlands is of public health concern, owing to the potentials of Heavy Metals (HMs) in SS to deteriorate soil, ground water quality and bioaccumulate in food chains. Conventional inorganic chelating agents used for removing HMs are mostly expensive and have negative environmental impact. Sewage sludge is the solid, semi-solid or liquid residue generated during the treatment of domestic sewage carried out in treatment works [2].

The increase in urbanization and industrialization has resulted in a drastic increase in the volume of wastewater and sludge generated worldwide. Sewage sludge is often considered for use in agriculture due to the abundance of organic matter and nutrients [7]. This is however limited by the presence of potentially hazardous constituents which include pathogenic organisms, heavy metals, soluble salts and other trace constituents present in sewage sludge [2]. The need to remove these contaminants from sludge becomes imperative. A critical step in the decontamination of the dewatered sludge is to remove the toxic heavy metals because they are not degradable (biologically and physico-chemically) and thus, once released into the soil environments, they have high potential to deteriorate soil quality and ground water supply and hence human health and safety [4]. Heavy metals such as Zn, Pb, Cu, Cr, Ni, Cd, and Hg constitute toxic pollutants found in sewage sludge. Heavy metals can accumulate in soil and in plants when sludge is applied as fertilizer and eventually can produce harmful effects in animals and humans. Due to the high level of awareness of the negative impacts of high concentration of heavy metals to the environment, stringent guidelines and verifications have been designed to limit the application of sewage sludge to agricultural soils

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II. METHODOLOGY AND LITERATURE

There is a great interest in spreading sludge on agricultural land due to the potential of recycling valuable components such as organic matter, nitrogen, phosphorus and other plant nutrients [10]. However, due to the physical and chemical processes involved in activated sludge wastewater treatment, heavy metals that are present in the wastewater tend to accumulate in the generated sludge. As a result, heavy metal levels are generally higher in the sludge than in the soil, where these elements can be retained indefinitely in cultivated soil layers. Therefore, repeated applications of sludge gradually increase the trace element content of the soil. High heavy metal content in sewage sludge limits their use as soil conditioners and organic fertilizers due to the high potential of the heavy metals to accumulate in food chain, deteriorate soil quality, ground water supply and hence, human health and safety. Inorganic chelating agents which are the most popular extracting reagents for heavy metal removal have been proved to be very efficient as they form stable complexes with most heavy metals over a broad pH range. However, their demerits which include persistence in the environment, adverse health effects and expensive cost have precluded their use. A great variety of extraction schemes have been developed to remove heavy metals from sewage sludge [3]

Toxicological studies have shown that some essential and non-essential elements become toxic at certain level of

concentration. Due to environmental restrictions and authoritative limitations, water quality monitoring in process effluents has attained high national and international priority, especially for heavy metals.
The last decades have seen an upsurge of interest in the application of liquid-solid separation, removal, preconcentration and subsequent determination of some toxic trace metal species.

The aim of the present work is to use new solid sorbent, date pits (DP) for the separation and simultaneous determination of some pollutants.
Innovative processes for treating wastewater containing heavy metals often involve technologies for reduction of toxicity in order to meet technology-based treatment standards. This article reviews the recent developments and technical applicability of various treatments for the removal of heavy metals from wastewater. A particular focus is given to innovative physic-chemical removal processes such as; adsorption on new adsorbents, membrane filtration, electro dialysis, and photo catalysis. Their advantages and limitations in application are evaluated. The main operating conditions such as pH and treatment performance are presented.
It is evident from survey that new adsorbents and membrane filtration are the most frequently studied and widely applied for the treatment of metal-contaminated wastewater. However, in the near future, the most promising methods to treat such complex systems will be the photocatalytic ones which consume cheap photons from the UV-near visible region. They induce both degradation of organic pollutants and recovery of metals in one-pot systems. It is important to note that the overall treatment cost of metal-contaminated water varies, depending on the process employed and the local conditions. In general, the technical applicability, plant simplicity and cost-effectiveness are the key factors in selecting the most suitable treatment for inorganic effluent.

Man's activities through industrialization, urbanization, technological development and agriculture, discharge heavy metals into the environment; this has become a matter of global concern over the past few decades because the presence of heavy metal ions in high concentration in the environment is detrimental to life With increased environmental awareness and activism of the observed that most countries of the world started adopting tougher legislation to regulate waste water discharged into the environment. This has led to efforts constantly made to develop new idea or modify existing technology on the removal of heavy metals from effluents before they are discharged into the receiving water bodies.

Several methods are currently employed in heavy metal removal from wastewater, but summarized their drawbacks as either technical inefficiency or cost ineffectiveness. , in reported the emergence of new approaches based on the use of natural inexpensive adsorbents for treatment of industrial waste water. In general, an adsorbent can be termed as a low cost adsorbent if it requires little processing, is abundant in nature, or is a by-product or waste material from another industry.
Huge amounts of date pits fiber is generated daily, which create environmental and disposal problems [6]. Therefore, application of these wastes as adsorbent offers highly effective technological means in dealing with pollution of heavy metals and solving their disposal problems, with minimum investment required. Therefore there is an urgent need that all possible sources of agro-based inexpensive adsorbents, should be explored and their feasibility for the removal of heavy metals should be studied in detail.

The objective of this study is to therefore contribute in the search for less expensive adsorbents and their utilization possibilities for various agricultural waste by-products which are in many cases also pollution sources.

The conceptual mechanism of heavy metal removal by chemical precipitation is presented in Eq.

$$M^{2+} + 2(OH)^{-} \longleftrightarrow M(OH)_2 \downarrow$$

Where M^{2+} and OH^{-} represent the dissolved metal ions and the precipitant, respectively, while $M(OH)_2$ is the insoluble metal hydroxide. Adjustment of pH to the basic conditions (pH 9–11) is the major parameter that significantly improves heavy metal removal by chemical precipitation Adsorption on new adsorbents Sorption is transfer of ions from water to the soil i.e. from solution phase to the solid phase.
Sorption actually describes a group of processes, which includes adsorption and precipitation reactions. Recently, adsorption has become one of the alternative treatment techniques for wastewater laden with heavy metals. Basically, adsorption is a mass transfer process by which a substance is transferred from the liquid phase to the surface of a solid, and becomes bound by physical and/or chemical interactions.

Various low-cost adsorbents, derived from agricultural waste, industrial by-product, natural material, or modified biopolymers, have been recently developed and applied for the removal of heavy metals from metal-contaminated wastewater. In general, there are three main steps involved in pollutant sorption onto solid sorbent:
(i) the transport of the pollutant from the bulk solution to the sorbent surface.
(ii) Adsorption on the particle surface.
(iii) Transport within the sorbent particle. Technical applicability and cost-effectiveness are the key factors that play major roles in the selection of the most suitable adsorbent to treat inorganic effluent.

Chelation:

Chelation is the formation of multiple coordination bonds between organic molecules and a transition metal ion leading to sequestration of the metal.

Conventional processes for removal:

The conventional processes for removing heavy metals from wastewater include many processes such as chemical precipitation, flotation, adsorption, ion exchange, and electrochemical deposition.
Chemical precipitation is the most widely used for heavy metal removal from inorganic effluent.

The toxicity of metal pollution is slow and interminable, as these metal ions are non-bio-degradable.

Heavy metals:

Known as trace metals, are one of the most persistent pollutants in wastewater and sludge [3]. The most commonly encountered toxic heavy metals in wastewater:

• Arsenic, Lead, Mercury, and Cadmium.
• Less common: Chromium, Copper, Nickel, Zinc.
• Many heavy metals are essential trace elements for humans, animals and plants in small amounts.
• In larger amounts cause acute and chronic toxicity.
• Linked to learning disabilities, cancers and even death.
• Heavy metals have inhibitory effects on the biological treatment process at the wastewater treatment plants.
• Limit the use of bio solids as fertilizer and may inhibit the digestion process in biogas plant [6].

Heavy metal pollution has become one of the most serious environmental problems today. The treatment of heavy metals is of special concern due to their recalcitrance and persistence in the environment [7].
In recent years, various methods for heavy metal removal from wastewater have been extensively studied. This paper reviews a new method that have been used to remove heavy metal from sludge which is date pits.

III. Results and Discussions

In this study, the adsorbent can be used as a low-cost condenser if it requires low processing, abundance in nature, secondary material or waste from another industry. Massive amounts of date pits are generated daily, creating environmental problems and disposal. Therefore, the use of these wastes as a premium provides highly efficient technological means in dealing with heavy metal pollution and solving disposal problems, with minimal investment required. Therefore, there is an urgent need to study all potential sources of cheap agriculture-based capacitors, and their feasibility for heavy metal removal should be studied in detail.

The aim of this study is to contribute to the search for less expensive absorbent materials and the potential for their use for various by-products of agricultural wastes that are often sources of pollution, date pits were used in this study.

The date pits was washed with plenty of warm water to remove the oil content and dried in the oven at 150 oC for 24 hours. After drying the samples are ground with a hand held grinder, sieved with a sieve size of 5 mm.

The main purpose of this study add date pits to thickened sludge after dewatering, date pits less expensive adsorbents and their utilization possibilities for various agricultural waste by-products which are in many cases also pollution sources.

In previous study, we would use nitrogen gas doses and alum doses with effecting bubbling pressure to show the relation between time with height of sludge, pH, BOD_5, TSS value and height of separated liquid and determine the best values of the doses.

Dissolved air flotation is a physical process for reducing the sludge volume and moisture content before dewatering stages [Conventional methods use air for flotation of the sludge].

As a unique and new idea, we introduce using N_2 gas instead of air for sludge flotation and then reduce the moisture content by simple dewatering methods.

Place of study treatment plant sewage in Port Said was chosen and controls basins station noting the increase a count of sludge in the pond bottom.

Sludge's were collected from the facultative Pond. A comprehensive report of the characteristics of these raw samples was kindly produced by the laboratory Chemists from the Port Said plant.

Which shows the results of sewage collected on 5 random days (covering the period of study) it can be seen that the sewage under consideration is of medium strength. Contains a sufficient amount of organic matter and nutrients required for the life of organisms, there is no fear of toxic substances, as indicated by COD: BOD ratio. It is noticed also that there is a considerable deviation in characteristics from day to day.

The model was manufactured in the sugar beet plant in Belqas and then transferred to the sewage plant in Port Said. The model body is made of a welded iron cylinder to withstand the internal pressure. Inside the pipe is a perforated pipe to distribute the gas inside the sample for ease of lubrication. Nitrogen gas as a source of nitrogen gas used in the experiment shown in Figure (1, 2).

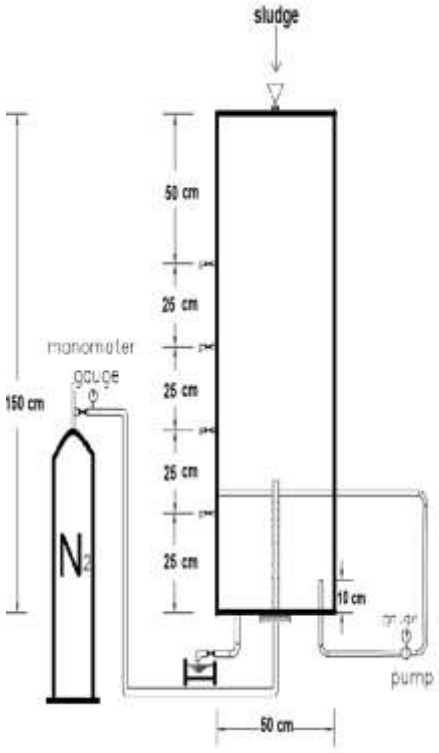


Fig 1. Sketch for model

Fig 2. Experimental model

The pilot plant was positioned in an open area in The Port Said Sewage treatment plant, and was exposed to sunlight and wind through the day; the data presented in this thesis was obtained during the six days period from 1/7/2017 to 6/7/2017.

Sludge treatment is focused on reducing sludge weight and volume to reduce disposal costs, and on reducing potential health risks of disposal options. Water removal is the primary means of weight and volume reduction.

The choice of a sludge treatment method depends on the volume of sludge generated, and comparison of treatment costs.

In previous study, the experiment was conducted in three stages:

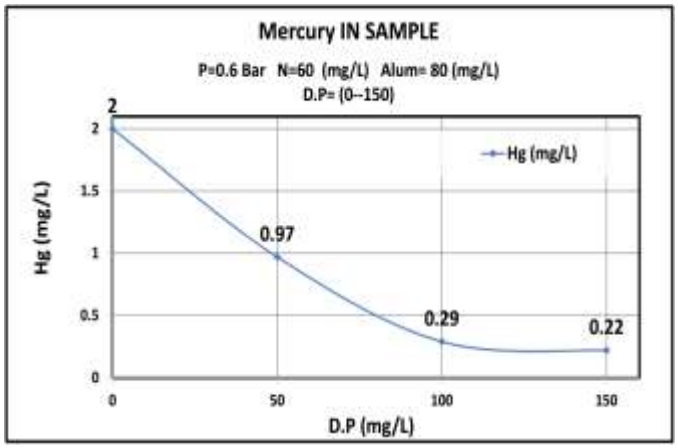
In the previous research [1] it was concluded that the experiment was carried out in three stage. In the first case, the best results were obtained when the bubbling pressure was 0.6 kg / cm2. In the second case, the best Alum dose was determined to help the sludge group and float. During the experiment a best dose is 80 mg / L was increased concentration of the sludge at a rate of 7-8 times. In the third case it was concluded that the economic dose of nitrogen gas is 60 mg / L with separation efficiency of 85% with increased sludge concentration of 8 to 9 times [1].

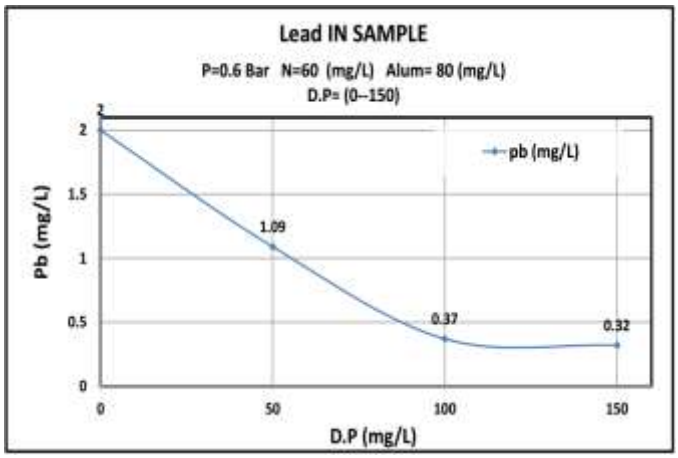
In this study date pits will used to treat sludge to remove heavy metals. The sample was injected with a constant doses of heavy metals (lead and mercury) in 2 mg / L.

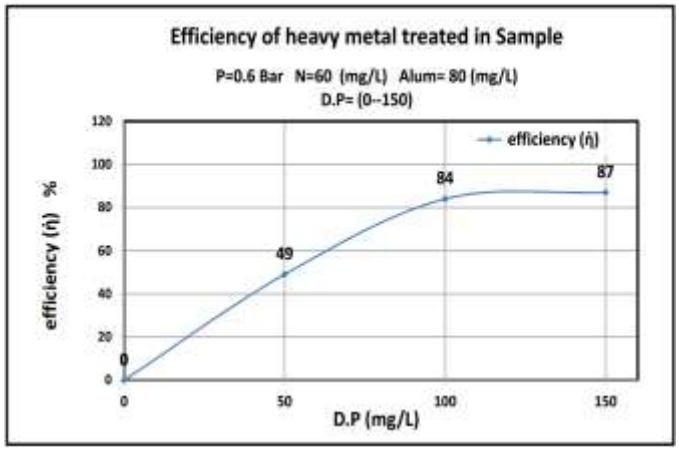
Dates pits were used in different doses 50 mg / L, 100 mg / L and 150 mg /L, The results were plotted as shown in curves:

Case
The sample is injected with specific Elements and Quantities of Heavy metals.
1. Mercury (Hg= 2 mg/L)
2. Lead (Pb= 2 mg/L)
By Using The same Treatment Elements With adding A new Element (Date Pits)
Nitrogen, Pressure and ALUM are constant ..
N=60 (mg/L) & (P= 0.6 Bar) & Alum=80 (mg/L)
Date Pits (D.P) is variable

D.P (mg/L)	Hg (mg/L)	pb (mg/L)	efficiency (ή)
0	2	2	0%
50	0.97	1.09	49%
100	0.29	0.37	84%
150	0.22	0.32	87%







IV. CONCLUSION

The experiments results and the previous discussion we can summarize the following:

- Over the past two decades, environmental regulations have become more stringent, requiring an improved quality of treated effluent. In recent years, a wide range of treatment technologies such as adsorption, has been developed for heavy metal removal from contam-inated wastewater.

- - We used a new type of Natural adsorbents material (date pits) is for removal of heavy metal
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- - The best result of the experiments in this study where amount of date pits was 100mg / L and the concentra-tion of heavy metals decreased by 85%.
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- Sewage sludge with low content of heavy metals can be recycled as a useful resource.

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