

*(Jordanian standard) No. 1145/1996*

*(Emblem)*

*Sludge: Uses of treated sludge in agriculture*

*Specifications and Standards Organization  
The Hashemite Kingdom of Jordan*

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## 1- Scope

This standard is concerned with the conditions that must be available in the sludge resulting from the stations for the treatment of sewage water intended to be used in agricultural land.

## 2- Definition

- 2-1 **Sludge:**  
The solid substance which are characterized by a damp or dry texture resulting from the treatment process of sewage water treatment stations.
- 2-2 **Sewage water:**  
The water resulting from domestic uses, and which may intermix with industrial water waste having a quality which conforms to the linking instructions issued by official authorities.
- 2-3 **Treated Sludge:**  
Sludge that has been exposed to one of the treatment methods indicated in the appendix to this standard.
- 2-4 **Dry Sludge weight:**  
The weight of the totally solid substances after dehydration of the sludge at a temperature of (103 – 105) C for a period of 24 hours.

## 3- General Conditions

- 3-1 It shall not be allowed to use untreated sludge for agricultural purposes.
- 3-2 The uses of sludge treated to **the first level** (as indicted in the attachment).
- 3-2-1 It shall be allowed to use the sludge for the purpose of improving the properties of the Badiya soil not used for agricultural provided that it will be immediately ploughed, in the lands set for forestation.
- 3-2-2 The treated sludge shall be added during the period between the beginning of April and the end of June.
- 3-3 The use of the sludge treated to the second level (as indicated in the **attachment**).
- 3-3-1 It shall be permitted to use the sludge in the cases indicated in item (3-2).
- 3-3-2 It shall be allowed to use it at the beginning of soil preparation until the planting of fruit trees, fodder, and field crops, taking into account not to harvest the fodder and field crops, or grazing before the lapse of three

months from the date of fertilization.

- 3-3-3 It shall not be permitted to use it for fertilizing the vegetables, green areas, parks, nurseries, and greenhouses, and the lands situated between residential compounds.
- 3-4 When adding the sludge, the sensitivity of the water reservoirs and their susceptibility to contamination must be observed. The distance of the land to which the treated sludge is intended to be added, from the water of dams and valleys as well as surface water, and water harvest projects, must be also observed.
- 3-5 The sludge treated for agricultural purposes must not be added, unless approval of the competent official authorities has been obtained.

#### **4- Standard Conditions**

The following standard conditions must be available in the treated sludge, when it is used for agricultural purposes.

- 4-1 The maximum limit for the sludge properties must be as shown in schedule No. (1).
- 4-2 The quantity of the treated sludge added to the soil annually shall be calculated according to the concentration of the element of lesser value, in accordance with the following formula :

$$\text{Average of the annual sludge addition} = \frac{\text{Average of addition to the elements level (kg/Hectare/365 day)}}{\text{Element concentration in the sludge sample (mg/kg-dry)X0.001}}$$

**(Metric ton/ Hectare/365 day)**

- 4-3 The bio-contaminants, when using the sludge treated for agricultural purposes, must be as shown in schedule No. (2).
- 4-4 The geometrical average must be taken for seven different samples of the treated sludge before using it or disposing thereof immediately.

**Schedule No. (1) – The Maximum of the Chemical Elements Concentration in the Treated Sludge:**

<b>Particularity</b>	<b>Concentration of Elements in The Sludge (Mg/Kg-dry)</b> <b>(1)</b>	<b>Addition rate to the elements level Kg/Hectare */ 365 days</b> <b>(2)</b>	<b>Maximum Limits of the Elements Accumulation in soil (Kg/Hectare)</b> <b>(3)</b>
As (Arsenic)	75	2	41
Cd (Cadmium)	85	1.9	39
Cr (Chromium)	3000	150	3000
Cu (Copper)	4300	75	1500
Pb (Lead)	840	15	300
Hg (Mercury)	57	0.85	17
Mo (Molybdenum)	75	0.9	18
Ni (Nickel)	420	21	420
Se (Selenium)	100	5	100
Zn (Zinc)	7500	140	2800
Co (Cobalt)	150	1.8	36

\* One hectare = 10 dunums

**Schedule No. (2) – The limits of Bio Contaminants of the sludge when used for Agricultural Purposes**

Bio-contaminants	Limits of Contaminants in sludge treated to the first level	Limits of contaminants in sludge treated to the second level
Colon fecal bacteria (the most probable number)	2 X 10 <sup>6</sup> bacilli per gram	1 X 10 <sup>3</sup> Bacilli per gram
Salmonella (The most probable number)	Unlimited	< 3 bacilli per 4 dry grams*
Worm live ova	Unlimited	< 1 ovum per 4 dry grams*
Intestinal viruses	Unlimited	< 1 (one) per 4 day grams*

\* Dry: The totally dry solid substances

**5- References**

- USEPA, Code of federal regulation, criteria for classification: of solid waste disposal practices (1992).
- USEPA, "Standards for the use or disposal of sewage sludge 1992".
- The European community "council directive on the protection of the environment, and in particular the soil, when sludge is used in agriculture, 1989".

- FAO paper No. 47 Wastewater treatment and use in agriculture 1992.

*Appendix (1)*  
*Sludge Treatment Levels*

(1) The first level aims at largely reducing the sludge content of pathogenetics. This can be achieved through one of the following processes:

**1- Aerial:**

**Digestion:**

This process shall be performed by stirring the sludge in the existence of air or oxygen, while maintaining the air conditions for a period of 40 days at a temperature of 20° C, or for a period of 60 days at a temperature of 15° C, with a decrease of not less than 38% for the volatile solid substances.

**2- Aerial dehydration:**

The liquid sludge shall be allowed to infiltrate and / or to be dried up in sand infiltration basins, or in paved or unpaved (tiled) basins, provided that the thickness of the sludge will not exceed (23 cm). However, the sludge must remain in the said basins at least for a period of 3 months, provided that the daily temperature will be above zero degree centigrade for a period of two months out of three months.

**3- Non – aerial digestion:**

This process shall be performed in the absence of air, provided that the sludge will remain for a period of 15 days at a temperature of (30 – 33) °C or for 60 days at a temperature of 20° C and with a reduction of not less than 38% of the volatile solid substances.

**4- Fermentation:**

This process shall be performed by using a container with a fixed ventilation shaft, or by placing the fertilizer in heaps, where the solid mass shall remain at a temperature of 40°C for a period of (5) days, provided that the temperature will reach more than 55°C for a period of not less than four hours during that period.

**5- Treatment by raising the figure of interaction (the hydrogen exponent) of the liquid sludge.**

This process shall be performed by adding a sufficient quantity of lime, in order to give a basic degree equal to 12(PH= 12) for a period of no less than two hours.

**6- Other methods:**

Any method which is capable of achieving the levels indicated in the previous methods, concerning the reduction of the volatile solid substances, or presenting the attraction of the pathogenetics thereto.

2) The second level aims at a larger reduction in the sludge content of the pathogenetics than that of the first level this can be achieved through one of the following processes:

**1- Fermentation / This method may be performed as follows:**

- A- By using the containers method, where by the sludge will be kept at temperature of not less than 55° C for a period of three days.

- B- By using the method of fixed ventilation tube, whereby the sludge will be kept at temperature of not less than 55° C for a period of 3 days.
- C- By using the method of finding (stacking) the sludge, whereby it will be kept at temperature of not less than 55° C for a period of 15 days during the sludge fermentation period.  
(Stirring must be maintained for at least 5 times during the high temperature period).

**2- Thermal dehydration:**

the sludge shall be dried up by removing the water there from through direct or indirect it contact with hot gases, where by the rate of humidity will be decreased to 10% or less, so that the sludge temperature will exceed 80°C, or that the damp temperature of the sludge heating gas will not be less than 80°C at the end of the heating process.

**3- Thermal operation:**

The liquid sludge shall be heated to a temperature of 180°C for or period of 30 minutes.

**4- Thermal Arial digestion:**

The liquid sludge must be stirred in the existence of air or oxygen, while maintaining the air condition for a period of 10 days at a temperature of (55 – 60) °C, with a reduction for the volatile solid substances at rate of not less than 38%.

**5- Other methods:**

Any method which is capable of achieving the abovementioned levels, concerning the reduction of the levels of volatile solid substances and prevention of the attract on of the pagthogenetics thereto.

The following methods, when added to the above-mentioned treatment methods, will reinforce the reduction of the pagthogenetics:

**A- Treatment by beta rays:**

The sludge shall be exposed to beta rays from the nuclear accelerator with doses of not less than (1) megarad at room temperature (20°C).

**B- Treatment by gamma rays:**

The sludge shall be treated by gamma rays from specific isotopes, such as Cobalt 60 or Cesium 137 with doses of not less than (1) megarad at room temperature (20°C).

**C- Pasteurization:**

The sludge shall be kept for a period of 30 minutes at a temperature of not less than 70°C.

**D- Other methods:**

Any other methods or acceptable operating conditions, if they lead to a reduction in the pathogenetics to the extent that we obtain by using any of the aforementioned methods.

**Reference:**

USEPA, code of federal regulation, criteria for classification of solid waste disposal peacetimes (1992).