

Removal of Heavy Metals (HM) from Wastewater by Dry Palm-tree Leave

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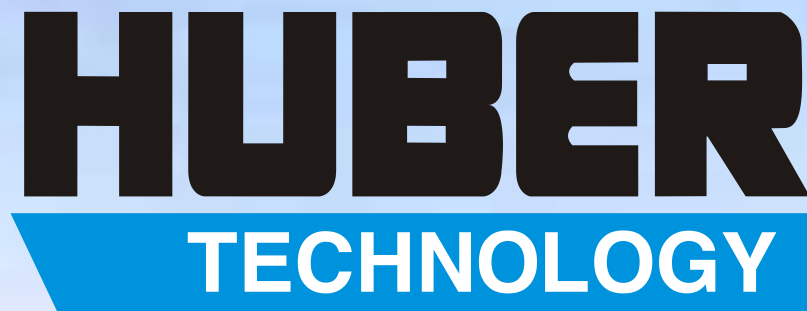
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Examples some projects in KSA

**Inletwork for Riyadh Sewerage and operation program – South Plants
Rakemax screens – 2005 and 2008,
Design flow of 40,000m³/day per unit**



**3 units of sludge dewatering centrifuges,
commissioned August 2008 – 45 m³/hr
per unit - Riyadh Sewerage and
operation program North plant**

Examples some projects in KSA

Complete screening Inletwork of Al-Kharj k29 STP 2008

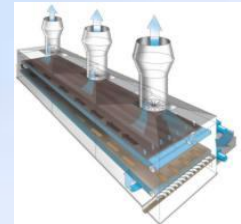
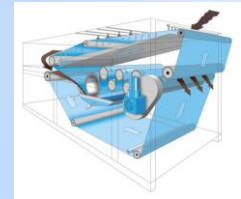
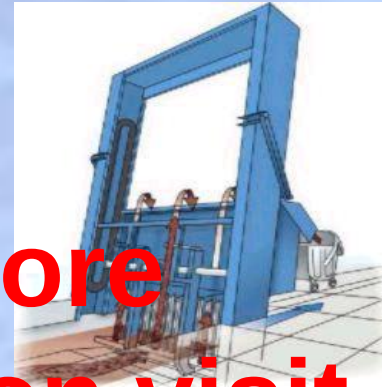
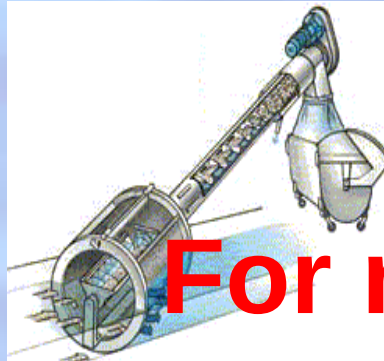


Step screens for Saudi Aramco (Rahima STP) - 2009



New projects under construction with Saudi Aramco:

- Safaniya STP - Complete STP with Membrane bioreactor.
- Udailiyah STP – Mechanical step screens.
- Rabigh STP – Mechanical step screens.
- Dhahran STP – complete inlet work.
- Complete preliminary treatment for Juaima gas plant.



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Content

- 1) Introduction.
- 2) Aim of the Study.
- 3) Environmental Significance of HM.
- 4) Agronomical significance of HM.
- 5) Health Significance of HM.
- 6) Removal of HM
- 7) Method and Material.
- 8) Results.
- 9) Conclusions.

1. Introduction

- Heavy metals are defined as those cations having an atomic number of greater than 23.
- They are not easily removed from wastewater by conventional treatment
- Examples:

Metal	Removal %
As	38
Co	37
Ni	59

1. Introduction

Several methods that have been employed for removal of heavy metals example are:

1. Post precipitation.
2. Chemical treatment.
3. Biological method.
4. Activated carbon adsorption.

But these methods show several limitations such as:

1. Costly
2. Weak effectiveness
3. Low efficiency

2. Aim of the Study

The aim of this work was to study the utilization of locally available very low cost material, namely dry palm tree leaves (DPTL), as filter media for removal of toxic metals from secondary effluent.

3. Environmental Significance

Heavy metals are stable and do not easily degrade with the following environmental features

- Accumulation (environmental build-up)
- Bioconcentration (within living organism)
- Biomagnifications (through the food chain)

3. Environmental Significance

Evidence of HM Accumulation in Soil:

Heavy Metal	Soil Depth, cm	Refrence
Co, Cd	10-15	Campbell 1983
Cu, Zn, Pb	60	Schalsa,1990

4. Agronomical significance

Accumulation of Heavy metals in Trees:

Type	Crop Type	Crop Part	Reference
Secondary effluent	Orange	Peel and Juice	Omran, 1998
Diluted wastewater	Corn	Root	Naheed, 1998

5. Health Significance

Toxicity of heavy metals depend on:

- Form of heavy metal
- Concentration
- Tolerance of receiving organism

Heavy metals are discharged from industries as well as Household.

5. Health Significance

House-hold Production of HM Russel, 1994

Heavy metal	mg/cap d
Cd	0.013
Cr	0.03
Cu	0.02
Pb	0.006
Ni	0.015
Hg	N/A
Zn	0.22
As	0.33

6. Removal of Heavy Metals

Biological Processes are not able to remove heavy metals simply because heavy metals are dissolved (are present in solution form)

Typical HM Removal Efficiencies for Primary and Secondary Treatment, Average Percent Removal:

Constituent	Primary Treatment	secondary Treatment	Tertiary Treatment
Cadmium	38	28	-
Chromium	44	55	5
Copper	49	70	19
Iron	43	65	56
Lead	52	60	46
Manganese	20	58	40
Mercury	11	30	16
Selenium	0	13	0
Silver	55	7	-
Zinc	36	75	55

6. Removal of Heavy Metals

Removal require adjustment of pH but this depends on specific metal ... Each metal have optimal pH-value for removal.

WASTEWATER DISPOSAL

6.171

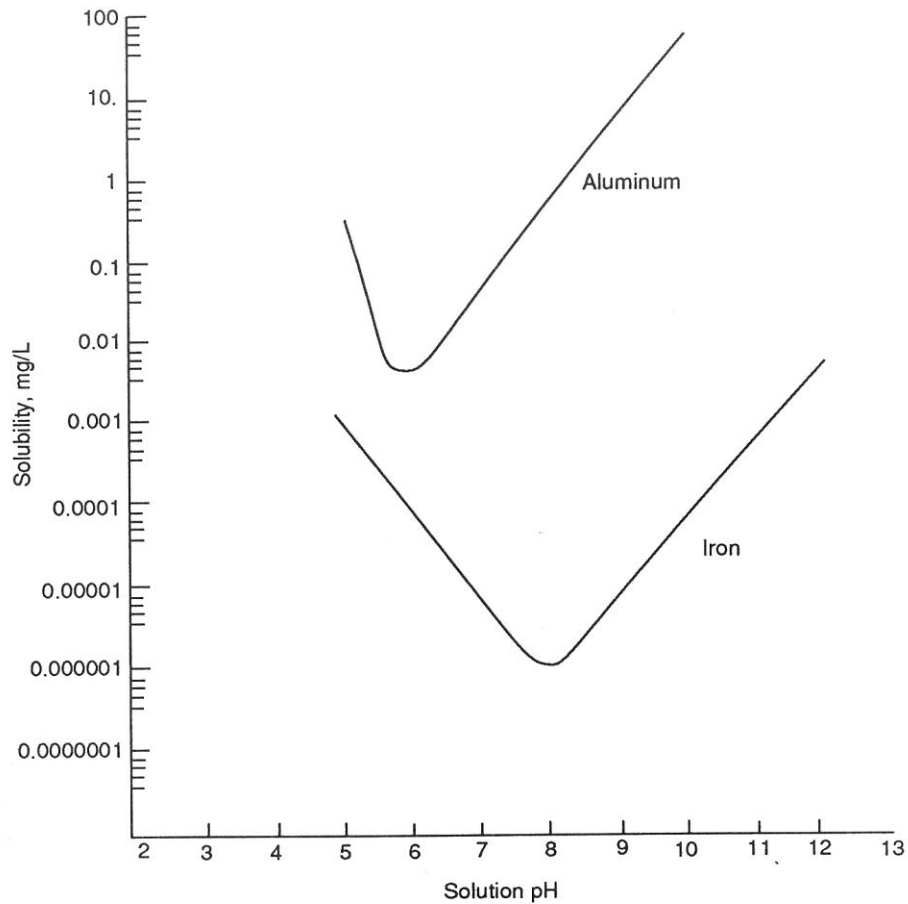


FIG. 6.90 Solubility of aluminum and iron hydroxides.

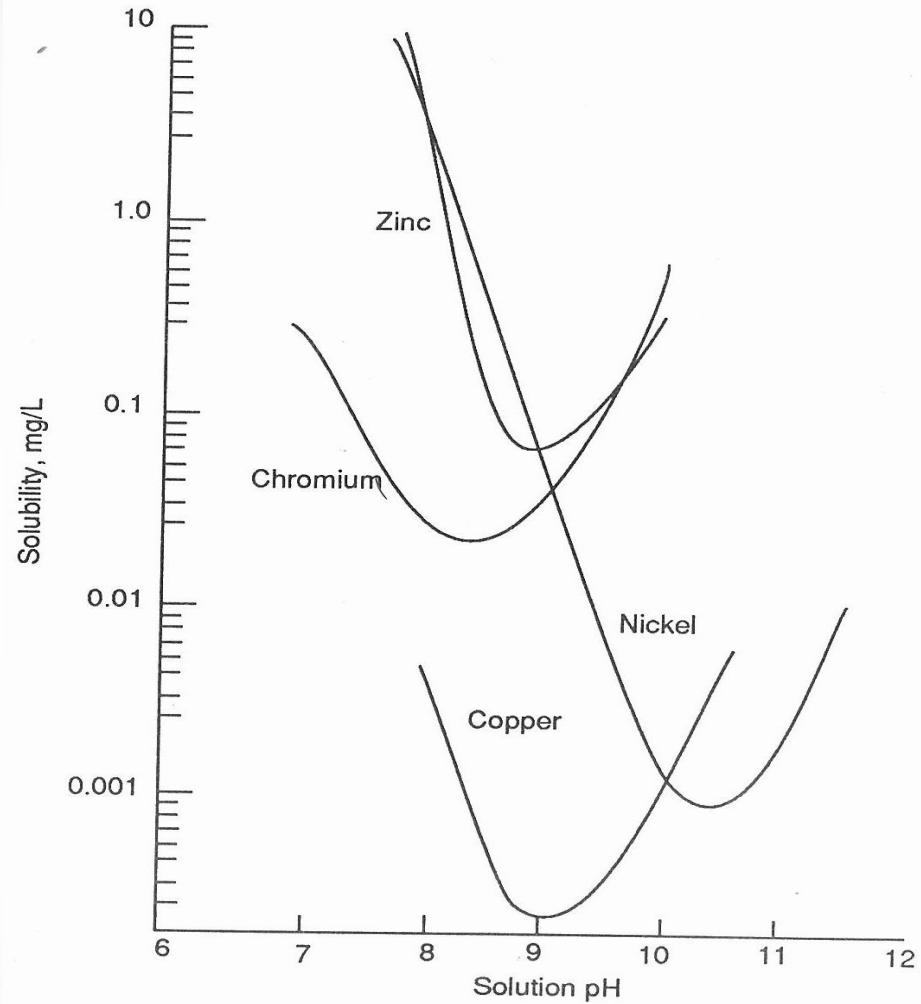


FIG. 6.89 Solubility of chromium, copper, nickel, and zinc hydroxides.

Precipitation through Flocculation Coagulation is an expensive method, Average Performance (%)

Constituent	Alum Addition	Lime Addition	Ferric Addition
Arsenic	83	6	49
Barium	-	61	-
Cadmium	72	30	68
Chromium	86	56	87
Copper	86	55	91
Iron	83	87	43
Lead	90	44	93
Manganese	40	93	-
Mercury	24	0	18
Selenium	0	0	0
Silver	89	49	89
Zinc	80	78	72

Limit values have been imposed for wastewater effluent and Soil:

Parameter	Effluent	Soil
Cu	0.20	5 - 20
Mn	0.2	20 - 24
Zn	2.0	25 – 60
Fe	5	40 – 150
Co	.05	10
Ni	0.2	1
Pb	5	13.5
Hg	-	0.30
As	0.1	14
Cd	.01	1.5
B	1.75	2

7. Method and Materials

The experiment was performed in a small (Package) treatment plant of residential villa-compound North of Riyadh city. The secondary effluent from the plant was used for this experiment.

7. Method and Materials

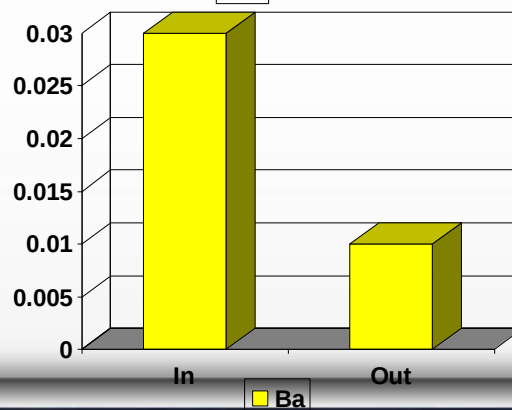
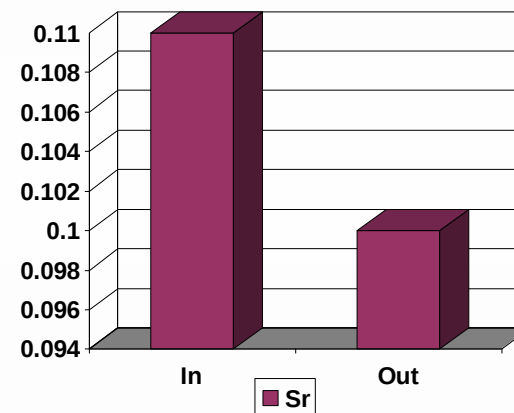
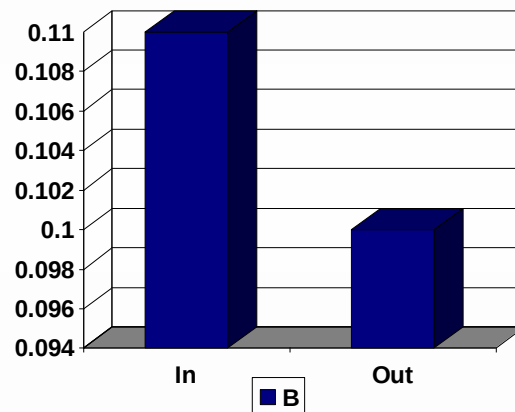
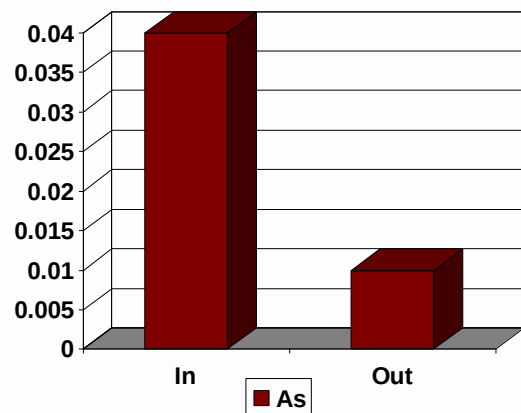
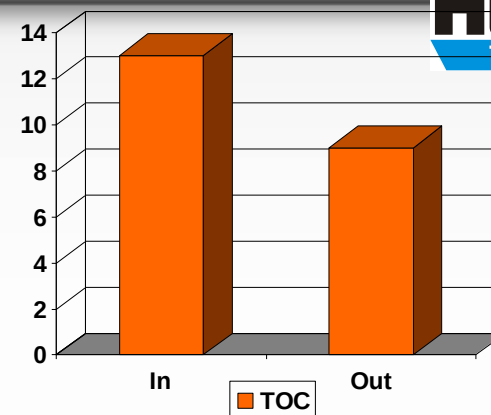
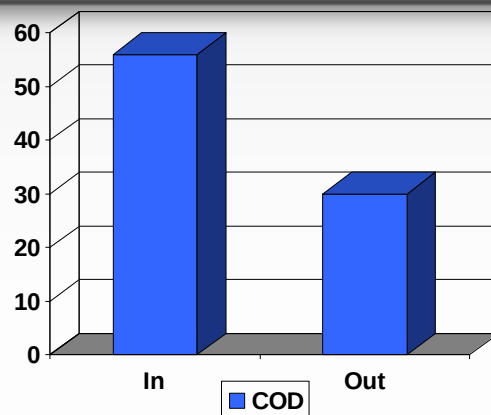
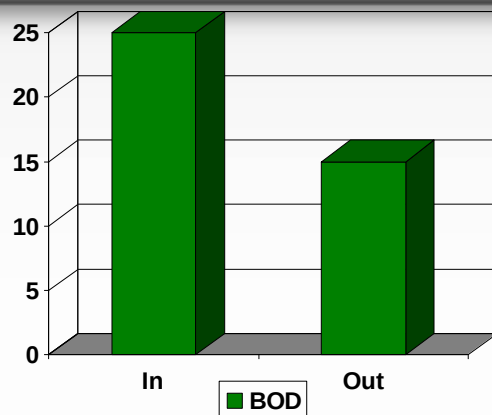
The effluent was sampled and fed to a column (0.25 m diameter, 1.0 m height) containing 0.45 m of shredded and condensed dry palm tree leaves; covered by a metal mesh.

7. Method and Materials

- The hydraulic loading rate was 5.0 m³/m².d
- Samples were collected daily for one month and analyzed for Heavy metal by spectro photometry using coupled plasma technique (ICP).

8. Results

	IN	Out	Unit
BOD	25	15	Mg/l
COD	56	30	Mg/l
TOC	13	9	Mg/l
As	0.04	0.01	ppm
B	0.11	.08	ppm
Sr	0.11	0.1	ppm
Ba	0.03	0.01	ppm



9. Conclusions

1. This method showed promising results in reduction of heavy metals namely; **As, B, Sr, and Ba**, from wastewater effluents using local and readily-available material; dry palm tree leaves.
2. More experiments should be conducted for longer period of time to validate this results.
3. Mechanisms of removal of Heavy metals by this method thought to be adsorption and sieving effects of the palm tree leaves.

