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(R) BAHRAIN: ASSISTANCE IN COMPOSTING MUNICIPAL WASTES, ~~BAHRAIN~~ PHASE I

DP/BAH/85/010

Technical report on background information and requirements
[illegible]

Prepared for the Government of Bahrain
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of

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R E P O R T

on Background Information and Requirements for Prequalification Proposal, dated 15 July 1986

1. Siting of the proposed facility:

   There should be 2 maps, one of them showing the overall location of the city of Manama, Tubli, road connection, etc., suggested scale 1 cm = 500 m. The second map shall include the site location with the sewage treatment plant and the existing [illegible] as well as the proposed [illegible], suggested scale 1 cm = 10 m.

2. Climatic conditions in Bahrain:

   No comment.

3. Raw materials for composting:

   There is a difference in the quantities of refuse between page 1 (500 t/d) and page 6 (2400 t/6d = 400 t/d).

   I would suggest the following:

   3.1.1 Refuse from the City of Manama and surrounding area arrives six days per week and amounts an average of 2400 tons per week. The daily quantity rises up to 500 tons per 24-hour period.

   3.1.2 Analysis of waste stream obtained in 1976 is as follows. For the time being an increase of food and vegetable residues is anticipated, which also results in an increase of the moisture content.

   3.1.3 to 3.1.8: No comment.

   3.2 The sewage treatment plant at Tubli (T.W.P.C.C. :

   It should be mentioned the year of start up and the treatment process, such as primary (sedimentation), secondary (biological) and tertiary (chemical, physical) treatment; add a brief description of the system.

   3.2.1 No comment.

   3.2.2 The quantity of thickened sludge seems to be higher as mentioned. A waste water treatment plant with a daily flow of 75,000 m³/d usually produces approx. 650 m³/d. On the other hand it is possible, that

75.000 m³ d is the plant capacity and the actual load is much lower resulting with 250 m³ d sludge. In that case I suggest to mention the present situation, but indicate that the sludge treatment should be designed for the full capacity of 650 m³ per day in the future.

3.2.3 to 3.2.6: No comment.

3.2.7 The suggested system for movement of the thickened sludge to the composting site is by pipeline. A storage facility may need to be erected as well as a dewatering facility to gain the proper moisture for mixing the sludge with refuse consistent with the requirements of the composting operation. The drying beds presently used are available for use as a [illegible].

4. Possible integration of the present Tubli refuse pulverizing plant:
Add more information such as lay out drawings, plant description and operation experience, date of start up, etc.

5. Need for potential uses of compost in Bahrain:
5.1 to 5.6: No comment.
add 5.7 Quality requirements for compost:
Compost is defined as the end product of composting where the decomposable organic substance is extensively broken down into a humus. Maximizing the content of humic substances - the portion of organic substances that has been converted into humic acids and its compounds - is the aim.
The physical and physical-chemical properties of compost affect its handling, tolerance by plants and influence on the soil texture. Important are the moisture, water capacity, fresh density, pH-value and conductivity. The required data are shown in the following table.

PHYSICAL PROPERTIES

	Symbol	*Unit*	*Nominal Range*
Moisture	M	% FS	25 to 35[1]
Water Capacity	WC	g/100 gDS	85 to 120
Fresh Density	FD	kg/l	≤0,85
pH value	pH	—	7,0 to 8,5
Conductivity (water soluble Salts)	CON	mS/cm	≤5,0

[1] *Higher moisture can be tolerated in loose compost.*
FS = fresh substance

The plant tolerance test shows the impact of compost on germination and growth of selected test plants compared to a base substrate e.g. manure . The field of compost application depends primarily on the plant tolerance. The test shall evaluate the fresh substance of the plants, germ formation and germ rate. The plant tolerance indicates the ratio between 100 percent of the plant mass grown on the base substrate and the actual plant mass grown on the test substrate.

PLANT TOLERANCE

	FSP	[illegible] days	[illegible]
Applicable as soil conditioner			
15% compost	≥ 80	—	—
Applicable as additive to potting soil			
15% compost	≤ 110	≤ (CS + 1)	100
30% compost	≥ 110	≤ (CS + 1)	100
45% compost	≥ 100		—

FSP = fresh substance of the plant
CS = compare substrate
**The plant tolerance test method is a standardized procedure. Generally it is not possible to transfer the test result to the actual application quantity of compost.*

Impurities are not specifically harmful to soil and plants. They have a negative impact on the compost quality because of their grain size and/or quantity. The impurities interfere with the appearance, increase the density of compost and diminish the portion of organic substance and nutrients. Furthermore they make the handling more difficult. Impurities to take into consideration are the grain size, glass, plastics, iron and other metals.

IMPURITIES

Bulkage	*Grain size*	*Unit*	*Nominal Range*
Oversized Grain	11.2mm[1]	% DS	0 to 3
Glass	2 mm	% DS	0 to 3
Plastics	4 mm	% DS	0 to 3
Iron	6.3mm	% DS	0
Other Metals	6.3mm	% DS	0 to 0.5

[1] A divergent grain size can be tolerated in special compost applications.

Heavy metals in compost must be considered because of their toxicological impact and prospective concentration. These metals are chromium, nickel, copper, zinc, cadmium, lead and mercury. Concentrations exceeding the tolerance values are caused by bad raw material that shall not be used for compost production. The actual compost application rates shall consider the heavy metal content of the soil and the kind of plants.

HEAVY METALS

Element	*Formula*	*Unit*	*Nominal Range*
Chromium	Cr	ppm DS	50[1] to 300
Nickel	Ni	ppm DS	30[1] to 200
Copper	Cu	ppm DS	[illegible]
Zinc	Zn	ppm DS	300 to 1500
Cadmium	Cd	ppm DS	1[1] to 6
Mercury	Hg	ppm DS	1[1] to 4
Lead	Pb	ppm DS	200[1] to 900

[1]*This value can be remained under.*

Epidemic control:

The microbial, aerobic fermentation is an exothermic process, whereas increased temperatures and biochemical reactions are inactivating pathogen germs including thermoresistant species. At the same time organic substance is decomposed. The composting mass must attain a temperature of 65°C or greater at a moisture of more than 40 percent for at least six days or two periods of three consecutive days during the composting period. To ensure the decontamination efficiency, it is imperative that the process and the end product be monitored for temperature.

6. A. and B.: No comment.

   C.3.

   add e. (page 8) Laboratory equipment.

   C.5. Fuel and power consumption and other maintenance costs (weir parts, lubrication, laboratory tests, etc.)

   C.4. No Comment.

   C.6.

   add g. Laboratory equipment.

7. Time schedule including proposed length of time required for design and construction, start up and training of staff.

9. Description of the compost produced by the plant:
   a. Expected quantity of the compost
   b. Expected analysis of the compost according to the requirements
   c. Expected final pathogen levels
   d. Environmental assessments such as public health, control of noise, odour, flies, rodents, etc.
   e. Other information

10., 11. and 12.: No comment.

[illegible]

10. Integral Ges.m.b.H., A-2481, Achau, Austria instead of Kuthner.
1. to 9. and 11. to 24.: No comment.
25. Dragon, France
26. Sofregaz, Clichy, France
27. Valorga, Vendargues, France
28. Tayler Woodrow, Western House, Western Avenue, London

DRAWINGS:

The drawings no. 156/101, 156/102, Refuse Pulverization Plant 1986 are useable, the remaining three drawings showing the sewage treatment plant and pumping station are not relevant.
Still there should be a road map as mentioned in this report no. 1 and a detailed description of the existing pulverization plant including mashinery and electrical equipment as well as operation and maintenance experience, e.g. arrangement drawings, motor list, power consumption, spare and wear parts, operation personnel.

p.s. to list of composting plant manufacturers:
The Tayler Woodrow process seems to be an anaerobic system instead of the required aerobic fermentation in a composting plant. Nevertheless it might be interesting to compare the alternative method with regard to the use of the end product in the agriculture.