Landfill Acceptance Criteria

Screening Values for Disposal of Waste to Landfill

Rev. 01

Introduction

One of the major challenges in Oman is how to landfill solid waste from the Omani industry. For landfilling be'ah has created 3 types of landfill.

1. Double lined landfill
2. Single lined landfill and
3. Inert landfill

In order to be able to deal with this in a competent way a set of "landfill acceptance criteria" has been developed with guidelines for how to dispose of the waste. By this the Leachate Concentration (LC) of elements and chemical substances must be determined using the Australian Standard Leaching Procedure **(ASLP).**

*Non-hazardous waste (or municipal waste) from household and waste from industries that resembles MSW (Municipal Solid Waste) will be placed in one lined landfills, but is **not** covered by this set of "landfill acceptance criteria". The assessment criteria proposed in this report does **not** represent a waste classification system (classifying waste into either hazardous waste or non-hazardous waste). Another system is required for that (e.g. the Globally Harmonised System).*

The reported system is only meant to set-up criteria for how to determine whether the waste shall be disposed of in an inert no liner landfill, a single lined landfill or a double lined landfill.

As a general principle, all organic waste must be incinerated before ending up in the landfills. Therefore a general rule, based on EU regulation, is that only 6 % of Total Organic Carbon (TOC) including Total Petroleum hydrocarbon (TPH) or mineral oil, is allowed in the industrial waste lined landfills. For inert waste the limit for TOC is 3 % and for TPH (C6-C40) is 0.05 % (500 mg/kg).

Waste that does not have an "S" in the HDPE Chemical Resistance Guide is not allowed in a lined landfill. The following waste shall not be accepted in the hazardous waste landfills, both unlined, single and double lined:

1. Liquid waste (include sludge's that cannot be taken by a shovel)
2. Waste which, alone or due to the condition in the landfill, is explosive, corrosive, oxidizing, flammable or highly flammable as defined in the GHS.

As soil in Oman often has a very low TOC value, also polluted soil can be placed in the landfill if it follows the criteria's in this guideline. If TOC is above 6 % it must be treated by incineration or desorption etc. before it can be landfilled.

Waste that have been classified as non-hazardous, but still shall be disposed of in a lined landfill can never be disposed of in a double lined landfill. **Waste classified as HW cannot generally be disposed in the inert landfill (unless special permit has been given by MECA) but there are exceptions e.g. asbestos and other inorganic materials, that can be accepted, as the waste, although hazardous, doesn't pose any threat to the groundwater through leaching etc.**

The dilution of waste solely in order to fulfil the waste acceptance criteria is prohibited.

Finally be'ah preserve the right to dismiss waste from landfilling if the waste is not in this guideline and if be'ah find that landfilling of this waste may create a present and/or future hazard (e.g. very toxic waste). In such case, the waste must be treated before landfilling.

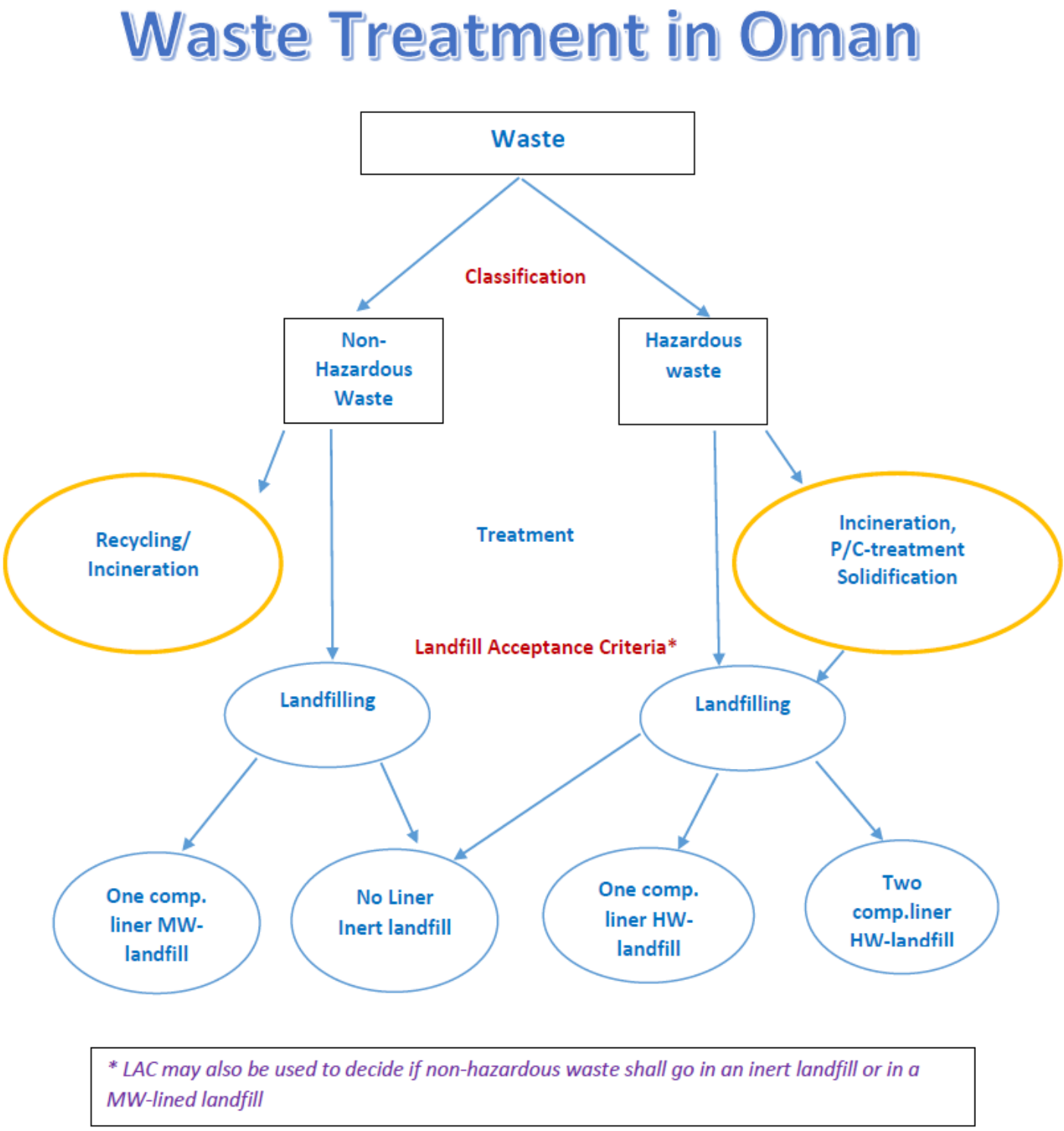

Figure 1: Flow diagram for waste showing that LAC can be used both in MW- and HW-treatment

Total Concentration and Leaching Standards for Assessment of Waste Landfilling in Oman

Table 1: Oman Standard Total Concentration and Leaching Concentration Procedure Threshold Values for Assessment of Waste Disposal to Landfill (OSLC (0, 1, 2) = *Oman Standard Leaching Concentration threshold value (0, 1, 2) and OSTC (0, 1, 2) = Oman Standard Total Concentration threshold value (0, 1, 2))*

Landfill Type	**Inert landfill if LC ≤ OSLC0, and TC ≤ OSTC0**		**Single lined landfill if OSLC0 < LC ≤ OSLC1, and/or OSTC0 < TC ≤ OSTC1**		**Double lined landfill if OSLC1 < LC ≤ OSLC2, and/or OSTC1 < TC ≤ OSTC2**	
Contaminants	**OSLC0 mg/l**	**OSTC0 mg/kg**	**OSLC1 mg/l**	**OSTC1 mg/kg**	**OSLC2 mg/l**	**OSTC2 mg/kg**
Metal Ion Contaminants						
As, Arsenic	0.01	**5.8**	1	**500**	4	**2000**
B, Boron	0.5	**150**	50	**15000**	200	**60,000**
Ba, Barium	0.7	**62.5**	70	**6250**	280	**25,000**
Cd, Cadmium	0.003	**7.5**	0.3	**260**	1.2	**1040**
Co, Cobalt	0.5	**50**	50	**5000**	200	**20,000**
$Cr_{Total,}$ Chromium Total	0.1	**46,000**	10	**800,000**	40	**N/A**
Cr(VI), Chromium (VI)	0.05	**6.5**	5	**500**	20	**2000**
Cu, Copper	2.0	**100**	200	**19,500**	800	**78,000**
Hg, Mercury	0.006	**0.93**	0.6	**160**	2.4	**640**
Mn, Manganese	0.5	**1000**	50	**25,000**	200	**100,000**
Mo, Molybdenum	0.07	**40**	7	**1000**	28	**4000**
Ni, Nickel	0.07	**800**	7	**10,600**	28	**42,400**
Pb, Lead	0.01	**20**	1	**1900**	4	**7,600**
Sb, Antimony	0.02	**10**	2	**75**	8	**300**
Se, Selenium	0.01	**10**	1	**50**	4	**200**
V, Vanadium	0.2	**150**	20	**2680**	80	**10,720**

Landfill Type	Inert landfill if LC ≤ OSLC0, and TC ≤ OSTC0		Single lined landfill if OSLC0 < LC ≤ OSLC1, and/or OSTC0 < TC ≤ OSTC1		Double lined landfill if OSLC1 < LC ≤ OSLC2, and/or OSTC1 < TC ≤ OSTC2	
Contaminants	**OSLC0 mg/l**	**OSTC0 mg/kg**	**OSLC1 mg/l**	**OSTC1 mg/kg**	**OSLC2 mg/l**	**OSTC2 mg/kg**
Zn, Zinc	5.0	**240**	500	**160,000**	2000	**640,000**
Inorganic Anions						
TDS	1000		25,000		100,000	
Chloride	300		30,000		120,000	
Sulphate	250		25,000		100,000	
NO_3 as N, Nitrate-N	11		1100		4,400	
F, Fluoride	1.5	**100**	150	**10,000**	600	**40,000**
CN^- (total), Cyanide Total	0.07	**14**	7	**10,500**	28	**42,000**
Pesticides						
Aldrin + Dieldrin		**0.05**				
DDT + DDD + DDE		**0.05**				
2,4-D		**0.05**				
Chlordane		**0.05**				
Heptachlor		**0.05**				

Note

1. In the EU the list of elements is limited to 12 and no organics are included, as co-disposal is not allowed. Also in Oman co-disposal of municipal waste with hazardous waste is not allowed, so the list is now restricted to inorganic waste and treasure limits of some pesticide in inert waste.

2. TDS=Total Dissolved Solids

Table 2: Waste Classes and Landfill Requirements

Waste Classes	Threshold OSLC & OSTC Determinants[1]	Waste Description	Management Requirement
Hazardous waste that must be treated before landfilling	LC > OSLC2, and/or TC > OSTC2	Waste that is too hazardous to go into a landfill, and must treated further before landfilling.	Cannot be disposed at any landfill facility without treatment to reduce the environmental risk. [2, 3, 4]
Double lined landfill	OSLC1 < LC ≤ OSLC2, and/or OSTC1 < TC ≤ OSTC2	Inorganic waste that exceed the limits of single lined landfill according to LAC.	Disposal only allowed at a hazardous waste disposal facility with double lining and leachate treatment system
Single lined landfill	OSLC0 < LC ≤ OSLC1, and/or OSTC0 < TC ≤ OSTC1	Inorganic waste that exceed the limits of inert landfill according to LAC.	Disposal allowed at a landfill site permitted in a waste disposal facility with single liner system with leachate treatment.
Inert landfill	LC ≤ OSLC0, and TC ≤ OSTC0	Inert waste with very low leachate generation	Disposal allowed at waste disposal facility without any liner system.

Notes:
1. LC = Leachable Concentration. TC = Total Concentration
2. Dilution of a waste to reduce the TC of any contaminant, so that it can meet the landfilling standards, is prohibited.
3. If the TC of a metal contaminant(s) is >OSTC2 and the concentration cannot be reduced by waste avoidance or by recycling/recovery, or it is not economically feasible e.g. due to very small quantities, the waste must be stabilised to a minimum of LC < OSLC2 and disposed to a hazardous waste landfill.

Inert Waste

Wastes, with all element and chemical substance concentration levels for metal ions and inorganic anions below the OSLC0 and OSTC0 values (LC ≤ OSLC0 and TC ≤ OSTC0), **as well as** below the following limits for organics and pesticides, are categorised as inert waste.

Table 3: Limits for inert waste

Chemical Substance in Waste	Total Concentration in mg/kg
Organics	
TOC	30,000 (=3 %)
BTEX	6
PCBs	1
TPH / Mineral oil (C6-C40)	500 (0.05 %)
pH*	Will be 6-9.5 until otherwise decided by MECA
Pesticides	
Aldrin+ Dieldrin	0.05
DDT+DDD+DDE	0.05
2,4-D	0.05
Chlordane	0.05
Heptachlor	0.05

If a particular chemical inorganic substance in a waste is not listed with corresponding OSLC and OSTC thresholds in this Standard, and the waste has been classified as hazardous due to the hazard characteristics of the particular substance, the waste is considered to be Hazardous Waste, and must go to a double lined landfill. If TOC > 6 % the waste must be treated before landfilling.

(4) If a representative sample of a hazardous waste cannot be taken or obtained that would enable accurate LC and TC analyses due to the nature of the waste, the waste is considered to be hazardous waste to be treated.

(5) Asbestos waste shall be looked upon as inert hazardous waste and can be placed in the inert landfill.

(6) Non-hazardous gypsum-based materials should be disposed of only in landfills for non-hazardous inert waste in cells where no biodegradable waste is accepted.

(7) If the TC of a chemical substance is > OSTC2, and the concentration cannot be reduced by waste avoidance, re-use, recycling or recovery, or it is not economically feasible e.g. due to very small quantities, the waste must be stabilised to a minimum of LC < OSLC2, and will then be considered hazardous waste.

(8) pH of waste for landfill:

a. Inert landfill $6 \leq pH \leq 9.5$ (Based on the Oman RD/115/2001 - law on Protection of sources of potable water from pollution according to Table A where the pH limit is 6-9) *and letter from MECA No. 51/5841 561/17 on 2.8.2017 NOL to receive slag with pH from 6-9.5 in IWTF of beah in Sohar Free Zone.*.

b. Single lined landfill and double lined landfill – no limit (however see in chapter 1.2 - the HDPE Chemical Resistance Guide)

c. pH of the sample is determined by following the ratio of 1:5 soil to water extraction based on AS 1289.4.3.1-1997 or any similar international standard method.

1.1 Leachable Concentration (LC) Analysis

(1) The LC of elements and chemical substances must be determined using the Australian Standard Leaching Procedure (AS 4439.1, 4439.2 and 4439.3)

AS 4439.1–1999: Wastes, Sediments and Contaminated Soils – Preparation of Leachates, Preliminary Assessment (Australian Standard 1999b)

• *AS 4439.3–1997: Wastes, Sediments and Contaminated Soils – Preparation of Leachates, Bottle Leaching Procedure* (Australian Standard 1997a)

• *AS 4439.2–1997: Wastes, Sediments and Contaminated Soils – Preparation of Leachates, Zero Headspace Procedure* (Australian Standard 1997b)

Non-putrescible waste to be disposed of without any other wastes: Use reagent water.
This is the used reagent in this LAC.