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Environmental Services Association of Alberta

Waste Classification and Landfill Disposal Criteria

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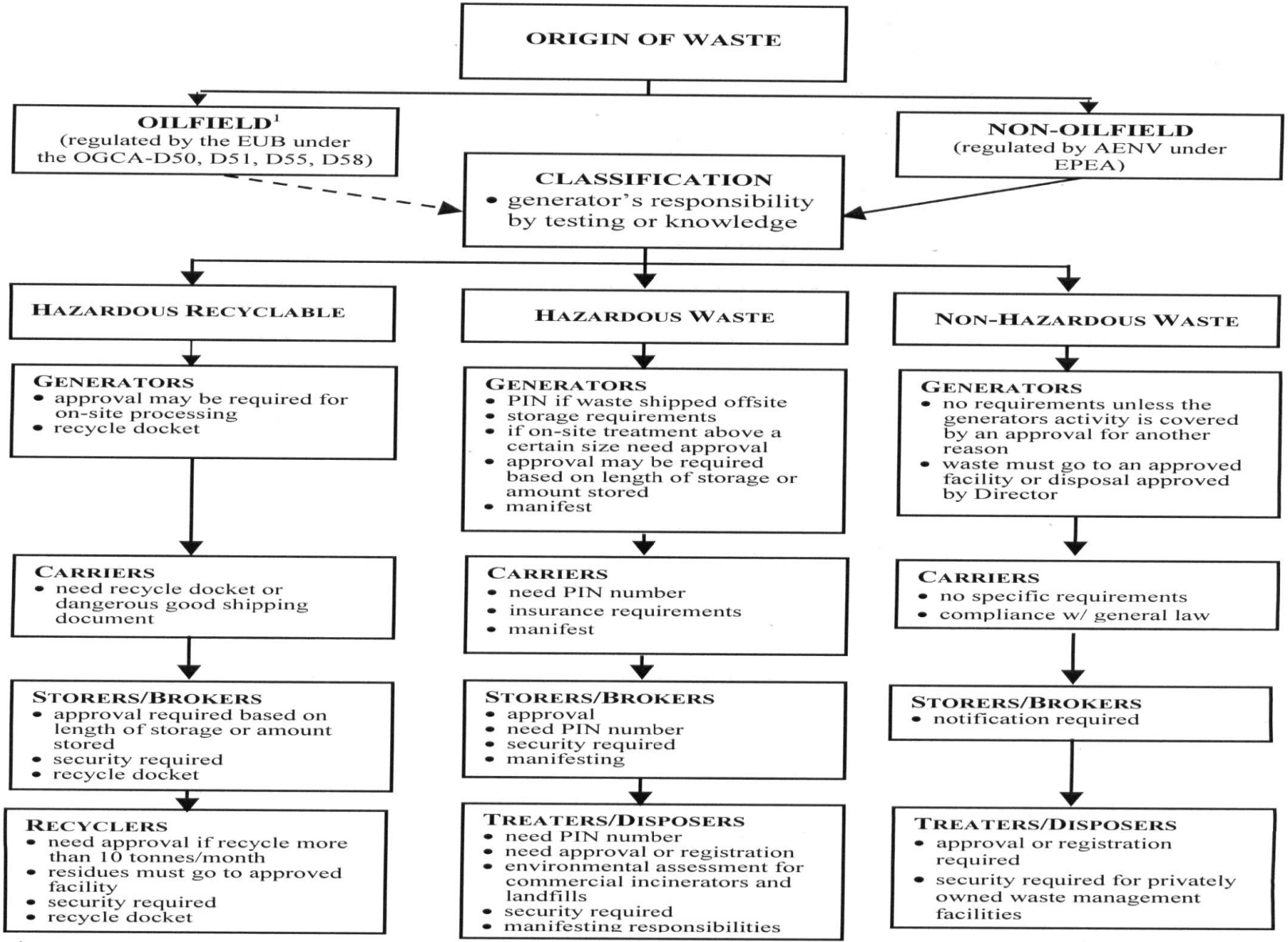
Waste Classification

- *Waste identification, characterization, and classification are the critical steps in determining the appropriate management of a waste.*

Classification and Land Disposal

- Waste Control Regulation
- Alberta User Guide for Waste Managers
- ERCB Directives 058
- AEW Policy ES-00-PP9 (Landfill Disposal of HW)
- AEW Policy ES-99-PP1 (Deepwell Disposal)
- ERCB Directive 051

Figure 1: WASTE MANAGEMENT REGULATORY RESPONSIBILITIES



[1] Oilfield waste is managed by a parallel system and when it enters an EPEA approved facility the above process applies.

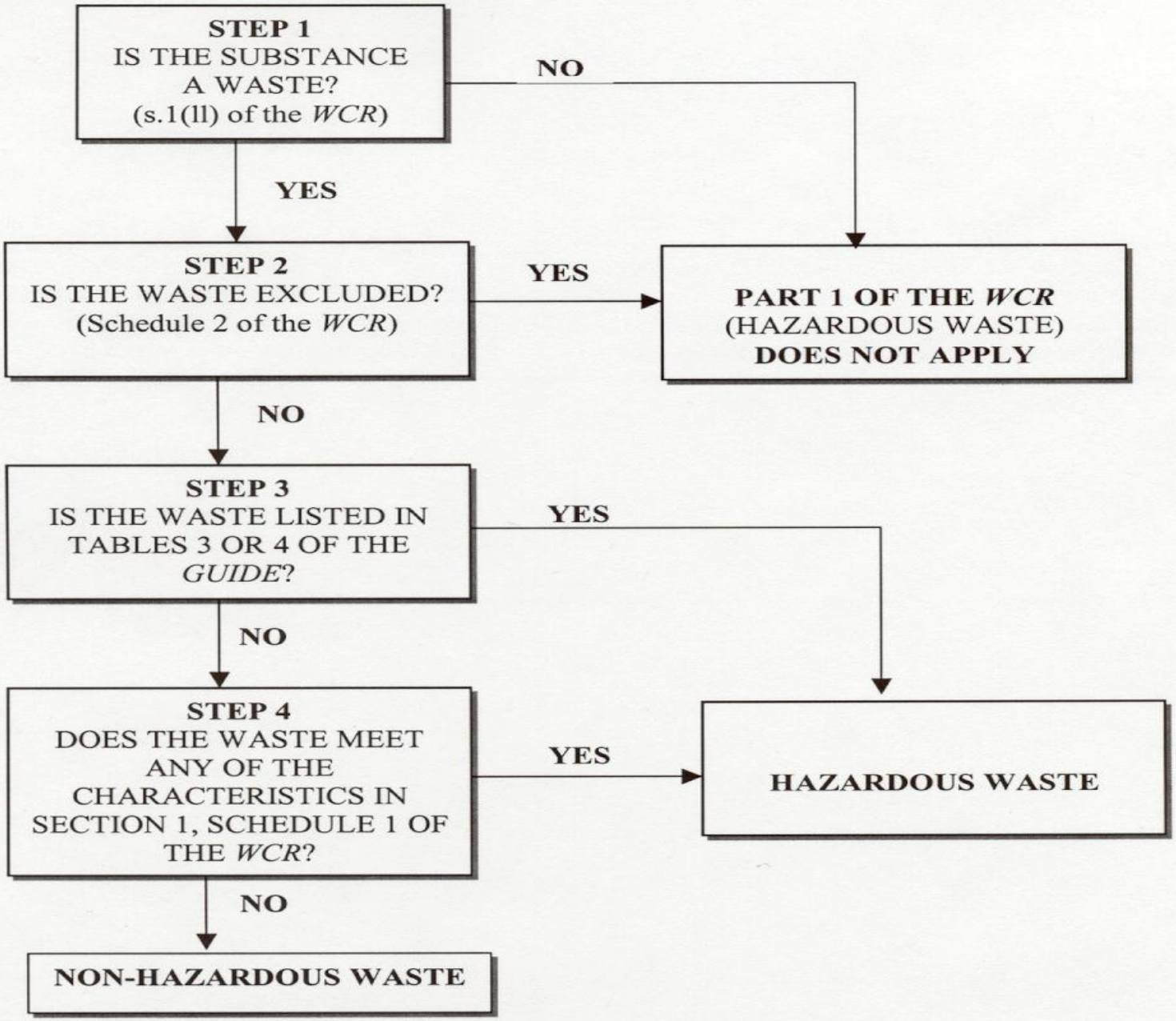
Why Testing a Waste?

- ***Legal Requirements*** (EPEA & WCR)
- ***Classification/M****anagement*
  - *Transportation* (EPEA, TDGR, & EIHWHMR)
  - *Storage* (OHS & EPEA)
  - *Treatment/BUW/AIP*
  - *Disposal* (landfills, deepwells, & thermal destruction)

When Testing Is Not Required?

- ***Regulatory Reasons*** [Schedule 2, s 1(h)]
- ***Generator Knowledge***
  - ***Previous Testing*** (Totals, Rule of Thumb, TCLP, etc.)
  - ***Understanding the Process***
  - ***MSDS***

Figure 1 - STEPS IN WASTE CLASSIFICATION PROCESS



Waste Classification

STEP 1 **- Is the substance a waste?** (or a **Recyclable?)**

- **product or material derived from waste,**
- **dust suppressing agents,**
- **fluids used to maintain oil/gas reservoir pressure, or**
- **soil conditioning agents.**

Oilfield Waste - Waste produced by the upstream oil and gas sector (OGCA, Regulations, and Directives)

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http://www.ercb.ca/portal/server.pt?

Waste Classification

STEP 2 - **Is the waste excluded?**
i.e., not regulated as HW because it is listed in

- **Schedule 2 of the *WCR*** (not regulated as HW) **, or**
- **Part 1A of the *Guide*, pages 9-23**

(Examples: drained oil filters, CKD, ashes from fossil fuels, TV, computers, fluorescent light lamps, etc.)

http://www.qp.alberta.ca (*AB Legislation*)
http://environment.alberta.ca/02806.html (*User Guide*)

Waste Classification

Substances not regulated as HW (listed in the *Guide*, Part 1A, pages 9-23):

- TDGR “p” wastes
- Common substances that may present hazardous characteristics (such as activated carbon, asbestos, fabrics, straw, petroleum crude, etc.) but have been de-listed by the Basel, OECD, or AENV.

Waste Classification

STEP 3 - **Is the waste listed in Tables 3 or 4 of the Guide?**

- Table 3 (waste types from specific and non-specific sources, and AB series)
- Table 4 (off-spec chemicals 4A and 4B and containers)

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http://environment.alberta.ca/02806.html

Waste Classification

STEP 4 – **Does the waste show any of the characteristics identified in Schedule 1 of the WCR?**

- Flammable (f.p. ≤ 60 ^{o}C)[1] – Class 3 or 4
- Reactive (includes oxidizers) – Class 4 or 5
- Corrosive (pH < 2 or pH > 12.5) – Class 8
- Toxic (acute or chronic) – Class 6.1 or Class 9.3
- PCB ≥ 50 mg/kg, D&D, containers, empty containers, D&D

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[1] Reference to TDGR recent changes (f.p. & class 9).

Flammable Waste[1]

- **Liquids**: f.p. < 60º C, closed cup test (class 3, flammable liquids)
- **Solids contaminated with flammable liquids**: f.p. < 60º C, closed cup test but disconnect the stirrer (class 4.1 flammable solids)
- **Readily combustible solids**: combustible burn test / burning rate test (class 4.1, flammable solids S waste)
- **Spontaneously combustible solids**: test for pyrophoric or self heating substances (class 4.2, flammable solids)
- **Solids that in contact with H_2O emit a flammable gas or spontaneously ignite** (class 4.3, water-reactive substances)

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1 TEST METHODS:
- *Alberta User Guide for Waste Managers, 1995*
- *ERCB Directive 58, 1996*
  TDGR Interim Compilation of Test Methods, Environment Canada, 1988.
- *Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, 5th edition, 2005*
  http://www.unece.org/trans/danger/publi/manual/rev5/manrev5-files_e.html

Toxic Waste – Acute

It is an **acute toxic** waste because it has

- an oral toxicity $LD_{50} \leq 500$ mg/kg (liquids) or 200 mg/kg (solids)[1],
- a dermal toxicity $LD_{50} \leq 1000$ mg/kg, or
- an inhalation toxicity $LC_{50} \leq 10\ 000$ mg/m^3 at NPT

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[1] The 1993 and 1996 versions of the WCR stipulated an oral toxicity $LD_{50} \leq 5000$ mg/kg with no distinction between liquids and solids.

Toxic Waste – Chronic (leachable)

It is **toxic** because it is in a dispersible form and produces a toxic leachate[1] that has one or more of the

- chemicals in Table 1 at levels ≥ 100 mg/L (former 9.2 TDGR substances)
- chemicals in Table 2 at levels ≥ the indicated limits (former 9.3 TDGR substances)

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1 The TCLP leachate results are expressed in milligrams of substance per liter of solution or leachate extract.

Disposal of Waste

- “Dispose”, when used with respect to waste at a landfill or by deepwell injection, means the intentional placement of waste on or in land as its final resting place [s 1(p) WCR]

Land Disposal

- Landfill Classification (WCR)
  - Class I Landfills, Class II Landfills, and Class III
- Deepwell Classification (D51)
  - Class Ia, Class Ib, Class II, Class III, and Class IV

Landfill Disposal

- Class III Landfills (for “inert waste”, only)
  - “Inert waste” means solid waste that, when disposed of in a landfill or re-used, is not reasonably expected to undergo physical, chemical or biological changes to such an extent as to produce substances that may cause an adverse effect, and includes, but is not limited to, demolition debris, concrete, asphalt, glass, ceramic materials, scrap metal and dry timber or wood that has not been chemically treated” [WCR, s 1(w.1)].

Landfill Disposal

- Class II Landfills (solid non-hazardous waste, only)
  - Waste pass applicable criteria
    - Show no core hazardous characteristics, and
    - Pass the TCLP when applicable)
  - Requires waste classification
  - Core vs. TCLP leachable waste
  - Rule of Thumb (total conc. vs. TCLP leachate conc.)
  - Units (mg/kg vs. mg/L)

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[1] Reference to PCBs (< 50 mg/kg) and tabled limits for specific solvents, halogenated organic compounds, and metals.

Landfill Disposal of HW

- Class I Landfills (specific HW, s 13 WCR)
  - Applies to solid HW, only.
  - 13(2)(a) and 13(2)(b) – HW w/ solvents and/or HOX[1] "… combined concentration less than 1000 mg/kg …"
  - 13(2)(c) – Solid HW not ignitable, reactive, or corrosive under the conditions of disposal
  - 13(2)(d) – Solid HW that produces a waste extract w/ metal levels less than specific values in mg/L.

[1] Reference to PCBs (< 50 mg/kg) and tables for specific solvents, AOX and metals.

Landfill Disposal

- **Rule of Thumb** (worst case scenario):

Total vs. TCLP leachates

"If the total concentration of the chemical of concern in a solid waste (including excavated CS) expressed in mg/kg divided by twenty produces a number that is less than the corresponding value in Table 2 of the Guide, then the waste is not a HW due to the presence of that constituent.

Landfill Disposal – Rule of Thumb

- Representative soil samples from an industrial site show a total concentration for lead between 140 mg/kg and 600 mg/kg. Is the soil potentially hazardous?
  - Assumptions:
    - 20 is the dilution factor for the TCLP, and
    - all the lead in the sample will be fully extracted into the TCLP leachate solution.
  - Calculation (best scenario)
    - 140 mg/kg/20 = 7.0 mg/kg
    - Assessment: 7.0 mg/L > 5.0 mg/L. From Table 2 of the User Guide we see that the WCR limit for Pb in 5.0
    - Conclusion: This means that this soil potentially shows hazardous characteristics but still apparently suitable to be put to various uses.

Alberta Tier I vs. WCR

- Tier I concentrations for some metals are not consistent with WCR HW criteria (Table 2 Guide)

Parameter	WCR TCLP (mg/L)	Alberta Tier 1 (mg/kg)				
		Natural area	Agricultural	Residential/PL	Commercial	Industrial
Arsenic	5.0	17	17	17	26	26
Cadmium	1.0	3.8	1.4	10	22	22
Lead	5.0	70	70	140	260	260
Mercury	0.2	12	6.6	6.6	24	50

Note: WCR TCLP leachate concentrations in mg/L vs. Alberta Tier 1 in mg/kg

Waste Classification and Disposal

- Correlation between total concentrations and TCLP leachate concentrations
  - Example 1: Pb contaminated soil
  - Example 2: Foundry baghouse dust

Waste Classification & Disposal

EXAMPLE 1: ***Lead Contaminated Soil from Lead-Acid Battery Recycling Facility***

Four composite samples from each one of the contaminated spots were collected and tested for the following parameters:

- pH;
- Total metals (Cd, Cr, Cu, Pb, Ni, Zn, and U); and
- TCLP for metals identified above.

Is this soil hazardous?

Is it suitable for recycling?

Where can it be disposed of?

The results are summarized below in the Table 2.

Table 2 – ANALYTICAL SUMMARY FOR SAMPLES COLLECTED FROM LEAD CONTAMINATED SOIL (Total, TCLP, and modified TCLP for metals)

Metals	#06 Total	# 06 TCLP	# 06 Modified TCLP	# 07 Total	# 07 TCLP	# 07 Modified TCLP	# 08 Total	# 08 TCLP	# 08 Modified TCLP	# 09 Total	# 09 TCLP	# 09 Modified TCLP
Cd	59	0.083	0.007	524	0.810	<0.003	13	0.033	<0.003	21	0.057	<0.003
Cr	699	0.047	<0.006	860	0.296	<0.006	428	0.058	<0.006	656	0.059	<0.006
Cu	922	0.41	0.01	237	0.48	0.05	741	0.50	0.01	889	0.41	0.03
Pb	29400	278	0.83	11900	95.2	0.06	17100	203	0.14	10100	125	0.12
Ni	32	2.71	<0.02	176	0.30	<0.02	29	0.13	<0.02	31	0.10	<0.02
Zn	479	5.06	0.137	3400	174	0.123	420	8.48	0.034	262	3.11	0.032

Waste Classification & Disposal

EXAMPLE 2: ***Foundry Baghouse Dust***

Four samples collected over a period of two months, analyses were done for the following parameters:

- Total metals (As, Ba, B, Cd, Cr, Pb, and Hg); and
- TCLP for the same metals.

Is this Waste Hazardous?

The results are summarized below in the Table 3.

Table 3 – ANALYTICAL SUMMARY FOR SAMPLES COLLECTED FROM FOUNDRY BAGHOUSE DUST (Total and TCLP metals)

Metal	Criteria (mg/L)	09/20		10/24		10/28		11/01		11/6		11/08		11/19	
		Total	TCLP	Total	TCLP	Total	TCLP	Total	TCLP	Total	TCLP	Total	TCLP	Total	TCLP
As	5.0	<30	<.0005	<30	0.0007	<30	0.0006	<30	<.0005	<30	<.0005	<30	<.0005	<30	<.0005
Ba	100.0	377	0.010	475	<0.001	345	0.010	274	0.025	278	0.010	270	<0.001	249	<0.001
B	500.0	167	4.78	118	4.73	108	5.19	75	4.34	97	3.82	74	4.47	98	4.47
Cd	0.5	697	33.3	656	33.8	757	37.9	585	31.5	596	26.1	524	26.8	663	26.8
Cr	5.0	2070	<0.003	1376	<0.003	1190	<0.003	957	<0.003	1300	<0.003	984	<0.003	1570	<0.003
Pb	5.0	46600	255	34000	271	42100	260	56200	350	45100	350	47700	169	49500	169
Hg	0.1	1.7	0.0024	1.15	0.0002	3.08	0.0026	2.17	0.001	1.42	0.001	0.95	0.0007	2.45	0.0018

Waste Classification & Disposal

Example 3

PRODUCED SAND - Analytical Data

	OILY SAND		*CLEAN SAND*	
Parameter	Total (mg/kg)	TCLP (mg/L)	Total (mg/kg)	TCLP (mg/kg)
Hydrocarbons				
Purgeables	2.1	< 100	< 0.5	< 100
Extractables	1400	560	36	< 0.5
Chloride	5620	374	40.7	5.1
Flash Point	> 60° C	-	> 60° C	-
Metal scan	(trace levels => not relevant)			
BTEX	(not detectable)			

QUESTIONS

- Is this waste hazardous? Is the testing appropriate?
- Is the cleaned sand an inert waste? Can it suitable to be used in reclamation of a gravel pit?

Landfill Disposal of HW

- AEW Policy ES-00-PP9 (2000)
  - Toxic Leachate Waste
  - Disposal of Solid HW at Class I Landfills
  - Test Required: TCLP
  - Units in mg/L, except for PCBs

Landfill Disposal of HW

- AEW Policy ES-00-PP9 (2000)

  "In the interim, while the *Guide* is being updated, the TCLP test should be used as the standard test method to assess whether or not solid hazardous waste containing one or more halogenated (excluding polychlorinated biphenyl) or non- halogenated organic compounds or leachable metals can be landfilled."

- Units in mg/L except for PCBs.

Landfill Disposal of HW

- Shall we test for each and every chemical identified in s 13 of the WCR? No!...
- Hydrotest fluids (waste w/ methanol): fp, toxicity

Analytical Protocols - Examples

The objective in conducting analytical determinations is to gather the maximum information at minimal cost without jeopardizing the quality of the data. The testing has to be comprehensive enough to characterize the waste for purposes of classification and, more importantly, for proper management.

In designing an analytical protocol, common sense should prevail in testing wastes only for those chemical constituents that are reasonably expected to be present and in consideration of the following:

- knowledge of the waste (prior testing, MSDS, etc.)
- raw materials, products, and by-products;
- technologies, chemical processes, and reactions;
- operational and waste management practices;
- classification criteria;
- indicator parameters;
- storage, treatment, and disposal alternatives; and
- compliance with clean-up criteria.

(1) Refinery Site

An example is given in Table 1, where petroleum hydrocarbons and heavy metals were the major contaminants at one refinery site.

Table 1 – Analytical Protocol for Soil-Sludge Mixture from an Oil Refinery

Parameter	Classification	Treatment	Disposal
pH	x	x	x
TPH	x	x	x
BTEX[1]	x		x
TCLP metals[2]	x	x	x
Total metals[3]		x	
Flash point	x	x	x
Heat value		x	

Notes:
[1] BTEX: benzene, toluene, ethyl benzene, and xylenes
[2] Metals in leachate (TCLP): As, Cd, Cr, Pb, and Hg.
[3] Total Metals: As, Cd, Cu, Pb, Hg, Ni, and Zn.

(2) Used Filters from Gas Plant

In assessing the characteristics of spent filters for purposes of waste class classification, the following data from at least four filters of the same type should be gathered over time:

- Waste identification:
  - Type of filter, mass, and process in which was used
- Analytical parameters:
  - Free liquids (Paint Filter Liquid Test)
  - BTEX (leachables and totals)
  - TPH
  - Flash point
  - Flammability
  - TCLP for metals
  - Heat value

Questions?

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