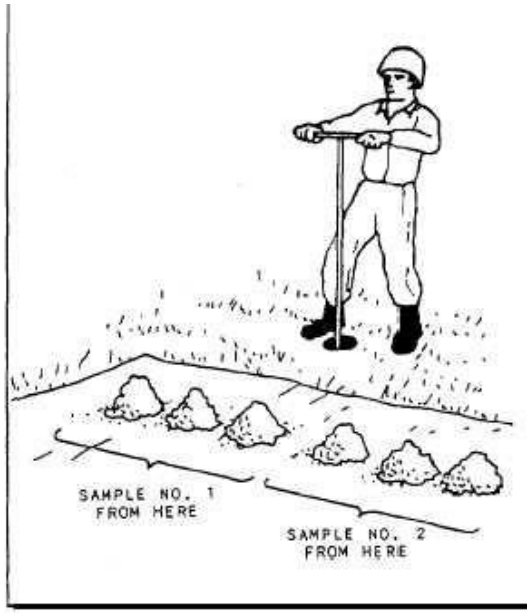
LED Recycling and Disposal

Division of Waste Management
Hazardous Waste Compliance Branch



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Department of Environmental Quality

2023 ESI Annual Conference

Today's focus

1. LED Lamps
2. Hazardous Waste
3. Universal Waste

LED Lamp's

VSQG; SQG; LQG

LED stands for Light-emitting diode

LED lamps are better then other lighting devices?

1. Light bulbs last longer
2. More durable
3. Offer better light quality

LED Lamp's

- Disadvantages of LED
  - High-up from cost
  - Transformer compatibility
  - Color's may shift over lamp life
  - Performance has not yet been streamlined
  - Overheating can cause reduce lamp life

LED Lamp's

LED's, how do they work?

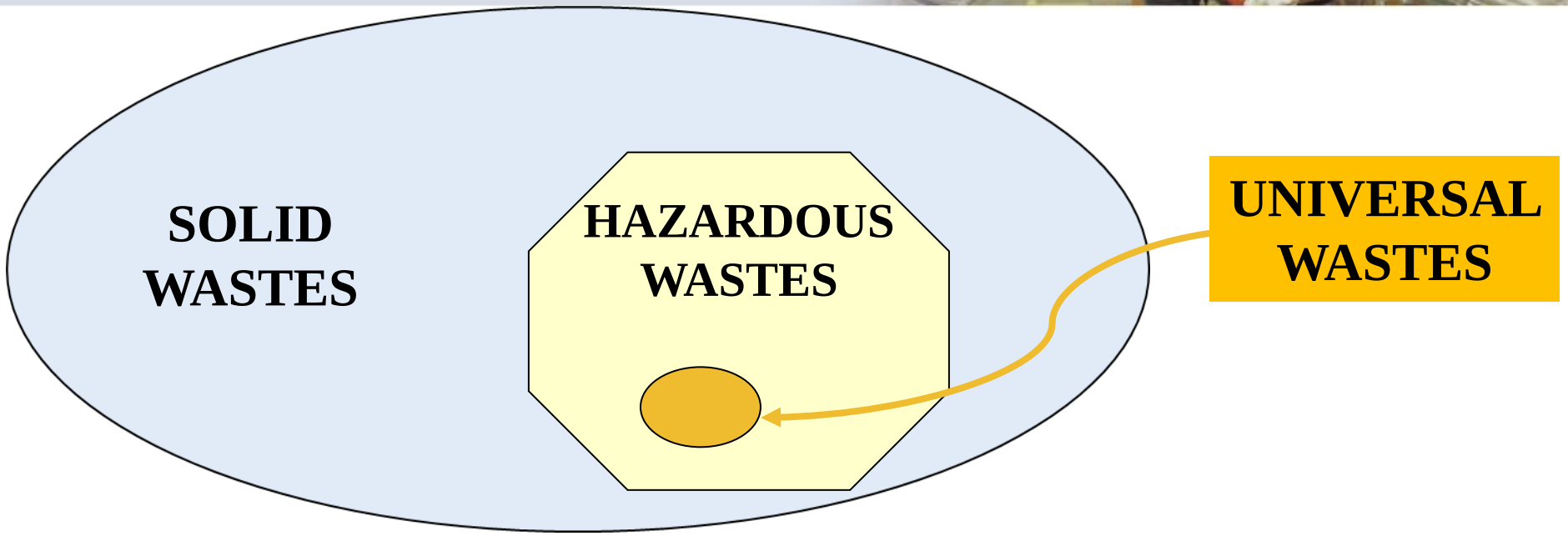
- Electric current pass through a microchip
- Illuminates the tiny energy source of light that we call LED (Visible light)
- Diodes uses for different light source:
  - Red: Aluminum gallium arsenide
  - Green: Gallium (III) nitride
  - Blue: Zinc selenide
  - White: Blue LED coated in phosphor

LED Lamp's

How to manage waste LED Lamp's

- Universal Waste Rules?
- Hazardous Waste Rules?

Universal Waste World



- Universal waste categories must be **hazardous waste before** they can be designated as universal wastes.
- They are **exempt** from full hazardous waste regulations **but must still be managed** separately from general trash.

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HAZARDOUS WASTE DETERMINATIONS

Characteristic Hazardous Waste

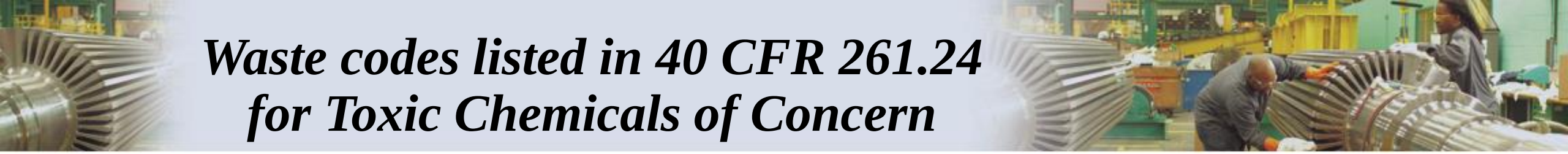
- Ignitability Waste — D001
- Corrosive Waste — D002
- Reactive Waste — D003

} ICR Parameters

- Toxic Waste — D004-D043 → Toxicity Parameters

Key Thought:
A waste is characteristic if it exhibits a generic property independent of its source.

Waste codes listed in 40 CFR 261.24 for Toxic Chemicals of Concern



TCLP Metals and Volatile Organic Compounds, Pesticides, Semi-Volatile Organic Compounds and Herbicides

Metals

Contaminant	EPA HW #	Regulatory Level
Arsenic	D004	5.0 mg/L
Barium	D005	100.0 mg/L
Cadmium	D006	1.0 mg/L
Chromium	D007	5.0 mg/L
Lead	D008	5.0 mg/L
Mercury	D009	0.2 mg/L
Selenium	D010	1.0 mg/L
Silver	D011	5.0 mg/L

Pesticides

Contaminant	EPA HW #	Regulatory Level
Chlordane	D020	0.03 mg/L
Endrin	D012	0.02 mg/L
Heptachlor (and its epoxide)	D031	0.008 mg/L
Lindane	D013	0.4 mg/L
Methoxychlor	D014	10.0 mg/L
Toxaphene	D015	0.5 mg/L

Herbicides

Contaminant	EPA HW #	Regulatory Level
2,4-D	D016	10.0 mg/L
2,4,5-TP (Silvex)	D017	1.0 mg/L

Volatile Organic Compounds

Contaminant	EPA HW #	Regulatory Level
Benzene	D018	0.5 mg/L
Carbon tetrachloride	D019	0.5 mg/L
Chlorobenzene	D021	100.0 mg/L
Chloroform	D022	6.0 mg/L
1,2-Dichloroethane	D028	0.5 mg/L
1,1-Dichloroethylene	D029	0.7 mg/L
Methyl ethyl ketone	D035	200.0 mg/L
Tetrachloroethylene	D039	0.7 mg/L
Trichloroethylene	D040	0.5 mg/L
Vinyl chloride	D043	0.2 mg/L

Semi-Volatile Organic Compounds

Contaminant	EPA HW #	Regulatory Level
o-Cresol	D023	200.0 mg/L
m-Cresol	D024	200.0 mg/L
p-Cresol	D025	200.0 mg/L
Cresol	D026	200.0 mg/L
1,4-Dichlorobenzene	D027	7.5 mg/L
2,4-Dinitrotoluene	D030	0.13 mg/L
Hexachlorobenzene	D032	0.13 mg/L
Hexachlorobutadiene	D033	0.5 mg/L
Hexachloroethane	D034	3.0 mg/L
Nitrobenzene	D036	2.0 mg/L
Pentachlorophenol	D037	100.0 mg/L
Pyridine	D038	5.0 mg/L
2,4,5-Trichlorophenol	D041	400.0 mg/L
2,4,6-Trichlorophenol	D042	2.0 mg/L

General Hazards of Universal Waste

- Your exposure to Universal Waste can cause chronic or acute illness.
- Releases to the environment can cause ecological damage.

33 As Arsenic	56 Ba Barium	48 Cd Cadmium	24 Cr Chromium
82 Pb Lead	80 Hg Mercury	47 Ag Silver	34 Se Selenium

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LED ≠ Hazardous Waste

- Any lamp (LED or otherwise) that does not exhibit one or more of the hazardous waste characteristics of 40 CFR 261 (ignitability, corrosivity, reactivity, or **toxicity**) would not be considered a hazardous waste and is not considered universal waste (40 CFR 273.5(b))

- North Carolina Landfill Prohibitions (North Carolina General Statute (NCGS) 130A-309.10)
  - Even when non-hazardous or exempt from hazardous waste regulation, specific items are banned from North Carolina (NC) landfills
  - Must not be disposed of in any **unlined** landfill in NC.

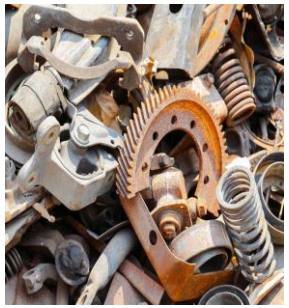
LED = Hazardous Waste = Universal Waste

Is it excluded from the Hazardous Waste Management Rules?

Almost all exclusion from the hazardous waste management rules are found at 40 CFR 261.

Circuit Printed Board

Scrap Metal



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Is it Excluded?

- Domestic sewage and mixtures of domestic sewage (261.4(a)(1))
- Industrial point source discharges (261.4(a)(2))
- Irrigation return flows (261.4(a)(3))
- Certain radioactive secondary materials (261.4(a)(4))
- In-situ mining materials (261.4(a)(5))
- Pulping liquors (261.4(a)(6))
- Spent sulfuric acid (261.4(a)(7))
- Secondary materials reclaimed in a closed-loop process in tanks (261.4(a)(8))
- Spent wood preservatives (261.4(a)(9))
- Coke by-product wastes (261.4(a)(10))
- Splash condenser residues (261.4(a)(11))
- Oil-bearing hazardous secondary materials generated and recycled within the petroleum refining industry (261.4(a)(12))
- Excluded scrap metal (261.4(a)(13))
- Shredded circuit boards ((261.4(a)(14))
- Pulping condensates derived from Kraft mill steam strippers (261.4(a)(15))
- Mineral processing spent materials being recycled (261.4(a)(17))
- Petrochemical recovered oil (261.4(a)(18))
- Spent caustic solutions from petroleum refining (261.4(a)(19))
- Hazardous secondary materials used to make zinc fertilizers (261.4(a)(20))
- Zinc fertilizers made from hazardous secondary materials (261.4(a)(21))
- Used cathode ray tubes (CRTs) (261.4(a)(22))
- Hazardous secondary materials generated and reclaimed under the control of the generator (261.4(a)(23))
- Hazardous secondary materials transferred for the purpose of reclamation (261.4(a)(24)and (25))
- Solvent-contaminated wipes that are sent for cleaning and reuse. (261.4(a)(26))
- Higher-value solvents transferred for the purpose of remanufacturing (261.4(a)(27)
- Recyclable Materials Utilized for Precious Metal Recovery (266.70)

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Recycling

- It gets a little trickier
- Issues:
  - Amount of glass
  - Cost recovery

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Universal Waste Management Rules
40 CFR 273

Requirements

- All universal waste lamps must:
  - Stored in structurally sound closed containers

Universal Waste Management Rules

Requirements

The container must be label as follow:

- Universal Waste “LED Bulbs”
- Waste “LED Bulbs”
- Used “LED Bulbs

Universal Waste Management Rules

Requirements

- Container must have the starting accumulation date
  - Manifest or bill of lading of last shipment
- Respond to breaks or evidence of leakage, spillage, or damage
  - Clean broken lamp's and place all pieces in the approved container
- Handlers of universal waste must inform all employees who handle or have the responsibility for managing universal waste.

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Universal Waste Management Rules

Benefits

- Universal wastes does not have to be accumulated at your hazardous waste central accumulation area (CAA)
- May keep universal waste on site for up to one year
- Weekly inspection does not have to be done
- Universal waste is not counted toward total monthly hazardous waste generation rate.

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Legitimate Recycling

- No matter which type of recycling we're talking about, in order to be excluded or subject to reduced requirements, the recycling must be legitimate and not sham (40 CFR 261.2(g); 40 CFR 260.43)

<u>Legitimate</u>: Lead-contaminated foundry sands reused in foundry molds (beneficial use)

<u>Sham</u>: Lead-contaminated foundry sands reused as playground sand

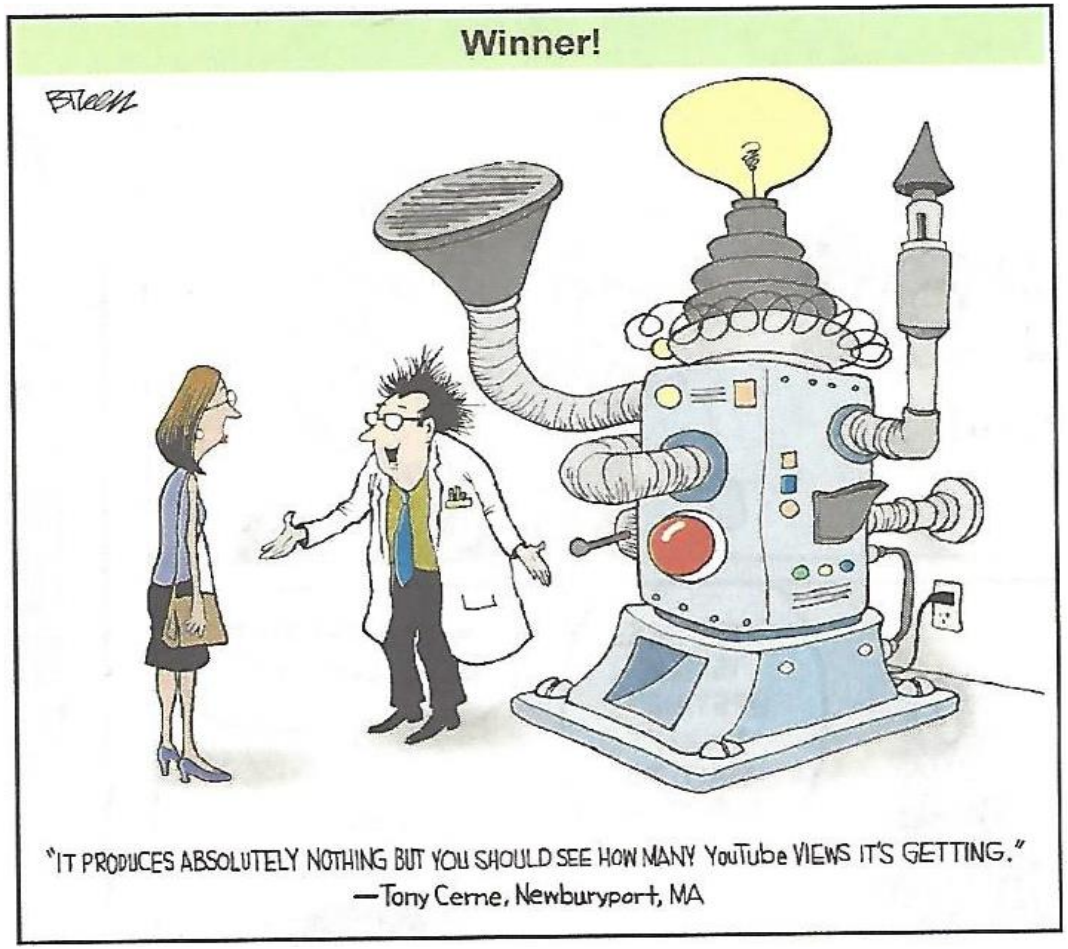
Legitimate Recycling

- Time Frame: These materials are subject to "speculative accumulation" limits, which means that (1) it must have a feasible means of recycling, and (2) 75% must be recycled or moved offsite for recycling every calendar year. The recycling timeframe must be documented (40 CFR 261.1(c)(8))

- Sham Recycling: 40 CFR 261.2(b)(4)

Sham Recycling

Key Thought:
Materials that are recycled may still be subject to the RCRA program



Source:
Hickory Daily Record Comics May 2020

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For additional information on the Waste LED Bulbs or the legitimate recycling, contact: NCDEQ / DWM / HWS

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Hazardous Waste Section Compliance Branch

North Carolina Department of Environmental Quality
Division of Waste Management
Hazardous Waste Section - Compliance Branch

REGIONAL INSPECTOR MAP

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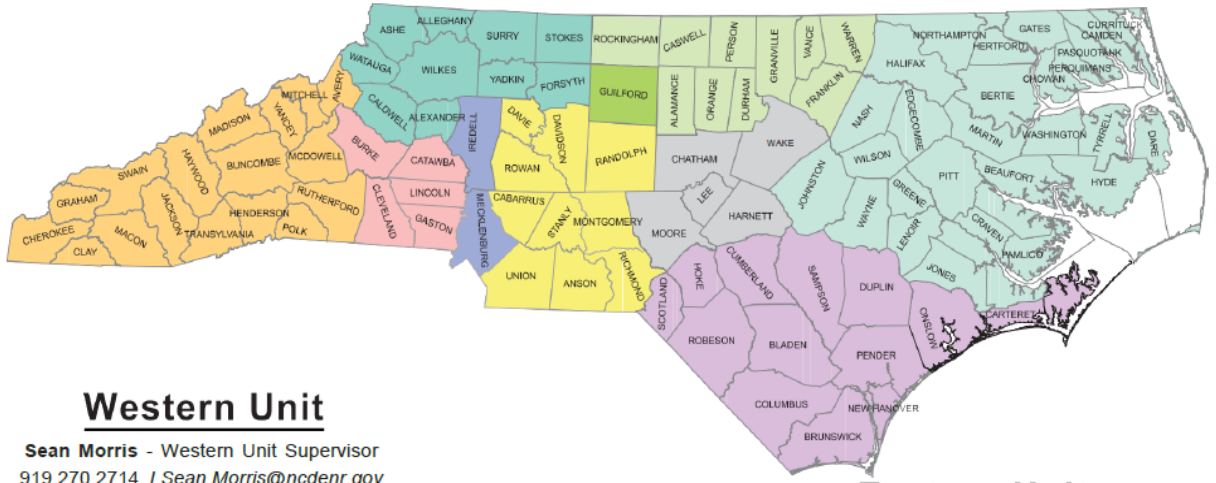

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