
TRASH ASH
A STUDY OF THE LEACHING OF HEAVY METALS
FROM MUNICIPAL SOLID WASTE INCINERATOR ASH
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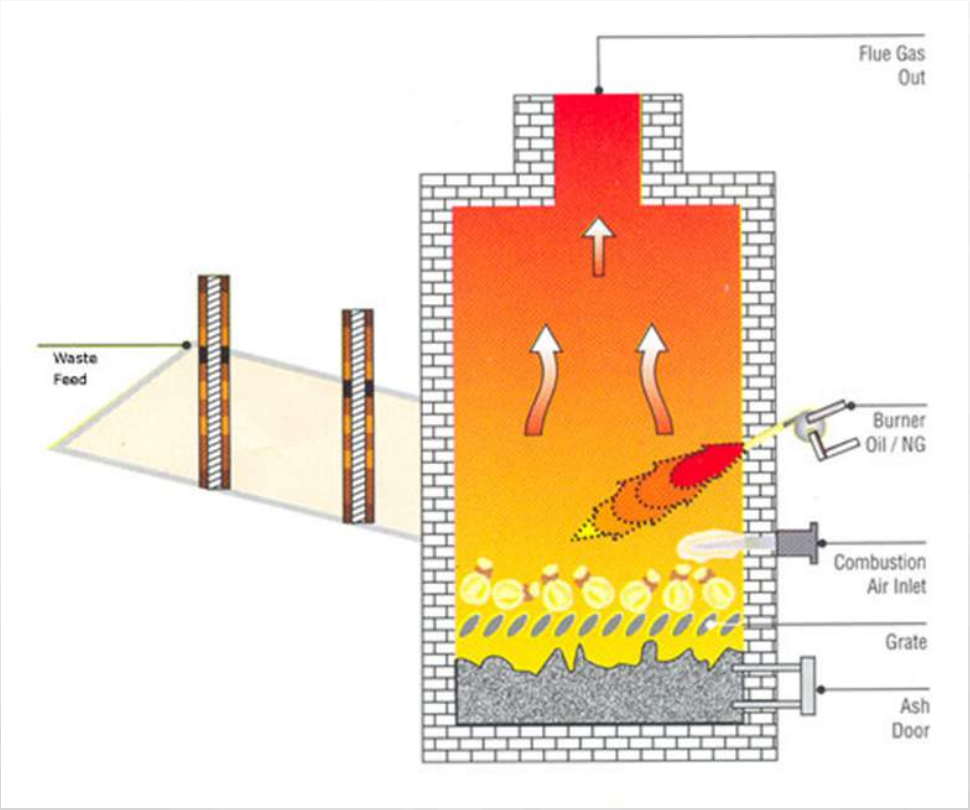
INCINERATORS

- MUNICIPAL SOLID WASTE INCINERATORS BURN EVERYDAY HOUSEHOLD TRASH
- INCINERATORS TURN TRASH INTO ASH (10% FLY ASH, 90% BOTTOM ASH), FLUE GAS, AND HEAT
- ASH GETS STORED IN ASH PITS AND USED AS AGGREGATES FOR BUILDING MATERIALS
- ASH CONTAINS HEAVY METALS THAT IF LEACHED, COULD POTENTIALLY INTERACT WITH THE GROUNDWATER


Flue Gas
Out
Waste
Feed
Burner
Oil / NG
Combustion
Air Inlet
Grate
Ash
Door

STUDY AREA

- SHANGHAI, CHINA

GUIDING QUESTION

- ZHENG ET AL (2007) STUDIED THE LEACHING BEHAVIOR OF HEAVY METALS IN THE ASH AND FACTORS INFLUENCING LEACHING
- DETERMINED CONCENTRATIONS OF LEACHED HEAVY METALS DEPEND ON PH
- AT WHAT PH WOULD THE HEAVY METALS LEACH AT DANGEROUS LEVELS?

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SOLUTION 1
     temp        25
     pH          7
     pe          4
     redox       pe
     units       mg/l
     density     1
     C(4)        1300
     Cl          610
     P           200
     S(6)        1000
     Al          1200
     Ca          4900
     Fe(3)       950
     Mg          520
     Cd          0.18
     Cu(2)       47
     Mn(2)       44
     Pb          10
     Zn          170
     Ni          3.8
     Cr(OH)2+    5.1
     -water      1 # kg
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SOLUTION 1

- BASED ON SAMPLES TAKEN FROM 2 SHANGHAI INCINERATOR ASH PITS
- TAKEN DIRECTLY FROM ZHANG ET AL. (2007)
- CONCENTRATION IS IN MG/L

MODELING

- FOLLOWED WHAT ZHENG ET AL. (2007) DID IN THEIR MODELING USING MINTEQ
- SURFACE COMPLEXATION MODELS
- VARIED THE PH
- LOOKED AT WHAT WAS PRECIPITATING AND WHAT WAS DISSOLVING (SI VALUES)
- CALCULATED CONCENTRATIONS OF MAJOR SPECIES
- COMPARED VALUES TO STANDARDS

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SURFACE_SPECIES
     Hfo_sOH  + H+ = Hfo_sOH2+
     log_k  7.18
     Hfo_sOH = Hfo_sO- + H+
     log_k  -8.82
     Hfo_sOH + Zn+2 = Hfo_sOZn+ + H+
     log_k  0.66
     Hfo_wOH  + H+ = Hfo_wOH2+
     log_k  7.18
     Hfo_wOH = Hfo_wO- + H+
     log_k  -8.82
     Hfo_wOH + Zn+2 = Hfo_wOZn+ + H+
     log_k  -2.32
SURFACE 1
     Hfo_sOH          5e-6     600.     0.09
     Hfo_wOH          2e-4
#     -Donnan
END
SOLUTION 1
    temp       25
    pH         12
    pe
    redox      pe
    units      mg/l
    density    1
    C(4)       1300
    Cl         610
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SURFACE COMPLEXATION MODEL INPUT

- HFO = HYDROUS FERRIC OXIDE

RESULTS – LEAD

- EPA STANDARD FOR DRINKING WATER: 0.015 MG/L
- HIGHEST CONCENTRATION WAS AT PH 10, CONCENTRATION OF CERUSSITE, $PbCO_3$ WAS 0.0000128 MG/L

RESULTS - COPPER

- EPA STANDARD FOR DRINKING WATER: 1.3 MG/L
- NO MAJOR COPPER SPECIES AT PLAY
  - CUOH(2) CONCENTRATION WAS HIGHEST AT PH10, WITH .000797 MG/L

RESULTS - ZINC

- EPA STANDARD FOR DRINKING WATER: 5 MG/L
- HIGHEST CONCENTRATION WAS AT PH 10, CONCENTRATION OF $Zn(OH)_2$ WAS 0.00121 MG/L

RESULTS - CADMIUM

- EPA STANDARD FOR DRINKING WATER: 0.005 MG/L
- HIGHEST CONCENTRATION AT PH 10, CONCENTRATION OF CDCO3 WAS 3.22 X10-8 MG/L

CONCLUSION

- THE CONCENTRATIONS OF LEACHED PB, CU, ZN, AND CD IN MUNICIPAL SOLID WASTE INCINERATOR ASH ARE VERY LOW AT EVERY PH
- PH OF 10 PRODUCED THE HIGHEST CONCENTRATION FOR ALL 4 HEAVY METALS
- THESE LEVELS WOULD NOT BE CONSIDERED DANGEROUS TO HUMAN HEALTH

REFERENCES

- ZHANG, H., HE, P., SHAO, L., LI, X., (2007). "LEACHING BEHAVIOR OF HEAVY METALS FROM MUNICIPAL SOLID WASTE INCINERATOR BOTTOM ASH AND ITS GEOCHEMICAL MODELING." MATERIAL CYCLES AND WASTE MANAGEMENT 10:7. DOI: 10.1007/S10163-007-0191-Z.