



Case Study of Health Impact Assessment on Incinerator Construction Project

- Human Risk Assessment due to Inhalation Exposure to Heavy Metals -

Korea Environment Institute (KEI)

Youngsoo Lee · Youngha Kim



Background & Objective

1. Legal base on HIA: “Environmental Health Act” Clause 13
 - This Act contains a clause related to implementation of HIA
2. Target projects of HIA(8): Attached table 1 of Enforcement decree on “Environmental Health Act”
 - Waste and excreta disposal Facilities Installation (Landfill, Incinerator)
 - Industrial Complexes Development
 - Energy Development (only Coal-fired Power Plants)
 - Urban Development
 - Roads Construction
 - Water Resources Development (Dam)
 - Railroads Construction
 - Airports Construction



Background & Objective

3. Conducted human risk assessment due to inhalation exposure to heavy metals emitted from incinerator to help effective HIA implementation

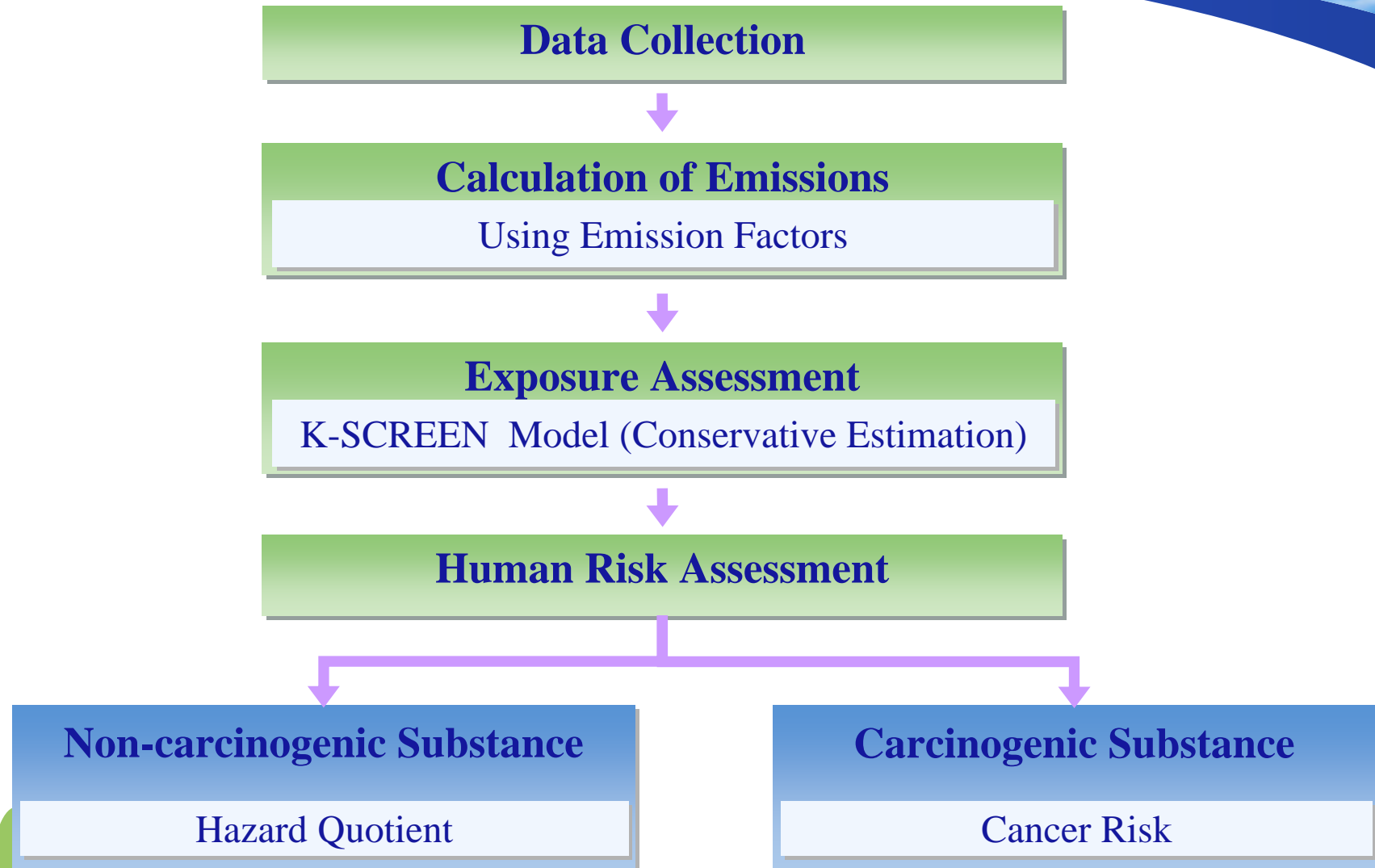


Overview of Incinerator

1. Stoker Incinerator
2. Capacity: 36ton/day(1.5ton/hr)
3. Mitigation Measures
 - SNCR
 - SDR
 - Bag Filter



Flow chart of Study



Calculation of Emission

Emission (kg/yr) = Incineration Capacity(ton/yr) × Emission Factor(kg/ton)

Emission Factor: MOE & NIER(2004)

[Result of Emission Calculation]

Pollutant	Emission Factor [kg/ton]	Incineration Capacity (ton/yr)	Emission (kg/yr)	Emission (g/sec)
As	2.623E-04	13,140	0.345E+01	0.109E-03
Cd	1.574E-04	13,140	0.207E+01	0.656E-04
Cr ⁺⁶	3.525E-04	13,140	0.463E+01	0.147E-03
Cu	4.946E-04	13,140	0.650E+01	0.206E-03
Hg	7.096E-04	13,140	0.932E+01	0.296E-03
Ni	1.626E-04	13,140	0.214E+01	0.678E-04
Pb	1.579E-04	13,140	0.207E+01	0.658E-04
Zn	9.110E-04	13,140	0.120E+02	0.380E-03



Input Parameter of K-SCREEN Model

□ Input Parameters

- Point Source
- Pollutant: As, Cd, Cr⁺⁶, Ni, Pb, Cu, Hg, Zn
- Stack Height: 30m
- Stack Diameter: 0.7m
- Gas Velocity: 16m/sec
- Gas Temperature: 421K
- Ambient Temperature: 290K
- Calculation Height of Concentration: 1.5m
- Rural Option



Result of K-SCREEN Model

Site	Separation Distance (m)	As (□/□)	Cd (□/□)	Cr ⁺⁶ (□/□)	Cu (□/□)
□ A Site	1,075	1.115E-04	6.693E-05	1.499E-04	2.103E-04
✓ B Site	560	1.247E-04	7.483E-05	1.676E-04	2.351E-04
✓ C Site	1,235	1.038E-04	6.231E-05	1.395E-04	1.958E-04
□ D Site	1,040	1.134E-04	6.808E-05	1.525E-04	2.139E-04
□ E Site	1,085	1.110E-04	6.658E-05	1.491E-04	2.092E-04
Maximum Concentration	359	1.406E-04	8.440E-05	1.890E-04	2.651E-04
Site	Separation Distance (m)	Hg (□/□)	Ni (□/□)	Pb (□/□)	Zn (□/□)
□ A Site	1,075	3.018E-04	6.914E-05	6.714E-05	3.874E-04
✓ B Site	560	3.374E-04	7.730E-05	7.506E-05	4.331E-04
✓ C Site	1,235	2.809E-04	6.437E-05	6.251E-05	3.606E-04
□ D Site	1,040	3.069E-04	7.033E-05	6.830E-05	3.940E-04
□ E Site	1,085	3.002E-04	6.878E-05	6.679E-05	3.854E-04
Maximum Concentration	359	3.804E-04	8.720E-05	8.464E-05	4.883E-04



Human Risk Assessment

Carcinogenic Substance

$$\text{CR(Cancer Risk)} = \text{IUR} \times \text{Predicted Concentration}(\mu\text{g}/\text{m}^3)$$

IUR: Inhalation Unit Risk $(\mu\text{g}/\text{m}^3)^{-1}$

10^{-6} : US Criteria for Risk Assessment

Non-carcinogenic Substance

$$\text{HQ (Hazard Quotient)} = \frac{\text{Predicted Concentration}(\mu\text{g}/\text{m}^3)}{\text{Reference Concentration}(\mu\text{g}/\text{m}^3)}$$

HQ > 1 : Adverse health effects are possible

HQ < 1 : No adverse health effects

Using an EPA IRIS data: RfC and IUR

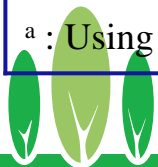


Result of Risk Assessment

Pollutant	CN	PC ^a (□/□)	IUR (□/□) ⁻¹	RfC (□/□)	CR	HQ
As	A	1.25E-04	4.30E-03	NA	5.36E-07	NA
Cd	B1	7.48E-05	1.80E-03	NA	1.35E-07	NA
Cr ⁺⁶	A	1.68E-04	1.20E-02	8.00E-03	2.01E-06	2.10E-02
Cu	D	2.35E-04	NA	NA	NA	NA
Hg	D	3.37E-04	NA	3.00E-01	NA	1.12E-03
Ni	A	7.73E-05	2.40E-04	NA	1.86E-08	NA
Pb	B2	7.51E-05	NA	NA	NA	NA
Zn	D	4.33E-04	NA	NA	NA	NA
Criteria					1.00E-06	1.00E+00

CN(Carcino Number), PC(Predicted Concentration), IUR(Inhalation Unit Risk), RfC(Reference Concentration), CR(Cancer Risk), HQ(Hazard Quotient), NA(Not Available)

^a : Using a “B site” Concentration for Conservative Calculation



Conclusion & Discussion

1. Hazard Quotient of all non-carcinogenic substances is calculated to be less than 1
2. Cancer risk of carcinogenic substances is lower than US criteria for risk assessment except Cr^{+6}
 - The Rank of carcinogenic human risk was $\text{Cr}^{+6} > \text{As} > \text{Ni} > \text{Cd}$
3. Technique of HIA, especially human risk assessment on heavy metals, would be applied to the incinerator construction project
4. There are few data for quantitative analysis such as RfC and IUR of heavy metals





Thank you for your Attention



Korea Environment Institute