

A case study of radiological impacts arising from coal mining and combustion

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Contents

- 1. Introduction**
- 2. Industry plant**
- 3. Radiological impact**
- 4. Summary**

1. Introduction

The total consumption of coal in China was about 3220Mt in 2010. This generated 500-800 Mt of coal ashes.

The radioactivity concentrations in coal widely vary, mostly $<100 \text{ Bq kg}^{-1}$ for ^{238}U and ^{232}Th , however, in some places, coal, uranium and some other elements occur together. For example, coal mines were found, containing 2.5-5.6 KBq/ Kg of U in Xinjiang, 0.45-8.6 KBq/K g of U in Yunnan.

1. Introduction

Research area in Lincang, southwestern Yunnan



2. Industrial Plant

There were tens coal mining sites in the research area, which produced coal about 100,000t as raw materials for rare metal concentrate products in 2010 .

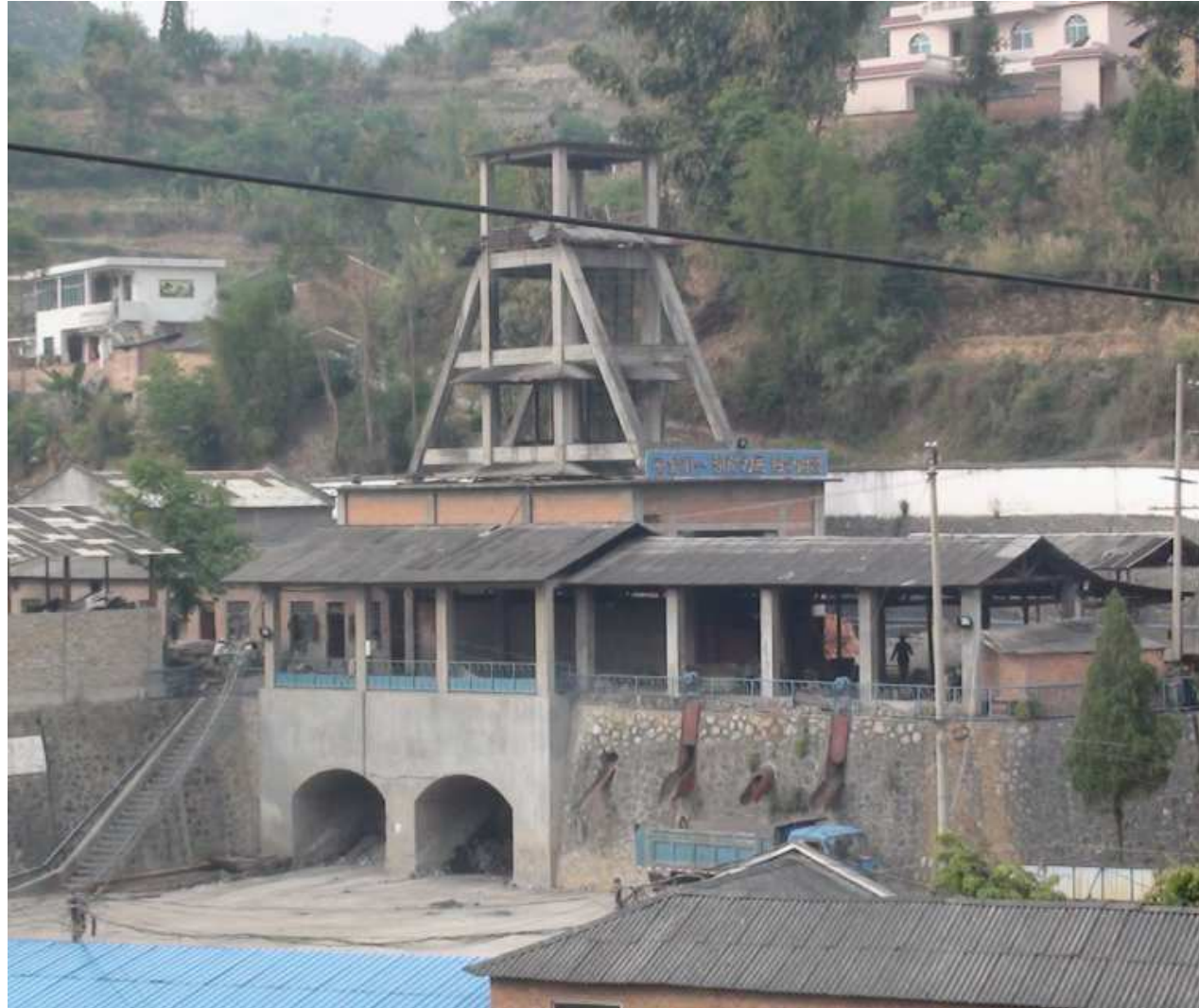
The plant has furnaces to burn coal or ores for fly ash (rare metal concentrates/products) ,meanwhile, large amount of bottom ash was produced .

Some bottom ash was used as building materials, the other was sent to disposal spots nearby the plant.

Waste water from plants and coal mines discharged into river.

Waste gas after desulphurization discharged to atmosphere.

A coal mining site



Coal underground was transported by conveyer belt

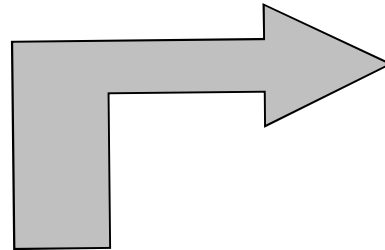
2. Industrial Plant



Coal after combustion, the content of rare metals in fly ash removed from bag filter increase greatly, about 2.32% ,comparing to 0.053% in original coal, meanwhile, the concentrations of some radionuclides in ashes increase.

2. Industrial Plant

Gases and fly ash are transported to dust collecting hose ,through snaked pipes for cooling, dust was removed from bag filter



bag filter



Furnace(>1000 °C)
(Coal burning)



Snake
pipes,
cooling

draft fan

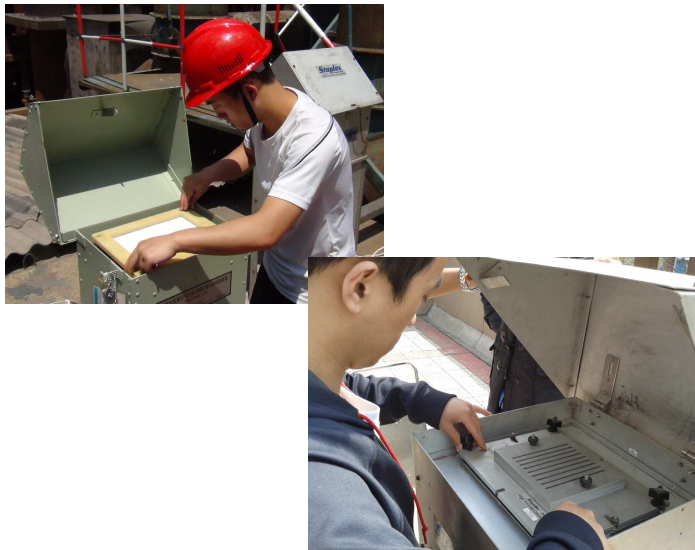
3. Radiological impact



Gama dose rate monitoring



Airborne radioactivity survey



Aerosol measurement



Indoor radon survey

3. Radiological impact

Sampling (Soil , ashes, water and biota)



3. Radiological impact

Regional Radiation levels in Lincang, Yunnan Province

Areas	Lincang		China
	Mostly range	average	average
Gama dose rate (nGy/h)	44 - 239	141	65
indoor radon (Bq/m ³)	50 - 75	73.3	44

3. Radiological impact

Samples	Radionuclides					
	²³⁸ U	²²⁶ Ra	²¹⁰ Pb	²¹⁰ Po	²³² Th	⁴⁰ K
coal(Bq/kg)	1200	1140	1170	1140	35.3	307
Bottom ash(Bq/kg)	1580	1610	570	200	58.3	546
Fly ash(Bq/kg)	4810	4730	42900	24300	128	668

The activity concentrations of radionuclides in coal, bottom ash and fly ash from the plant.

3. Radiological impact

Aerosol measurements (mBq/m³)

locations	²³⁸ U	²²⁶ Ra	²¹⁰ Pb	²¹⁰ Po
plants	1.48-2.73	1.36- 2.22	16.7-29.2	23.6-40.9
public	0.12-0.26	0.04-0.08	1.66-2.24	1.04-1.82

Concentration in contaminated Soil (Bq/kg)

samples	²³⁸ U	²²⁶ Ra	²¹⁰ Pb
Upper lay	295	312	1280
Down lay	246	230	942

Concentration in biota (tobacco leaves)

Nuclide	Contaminated Soil	Bacbground
²¹⁰ Pb (Bq/kg)	2.0-5.6	2.7
²¹⁰ Po (Bq/kg)	44-83	9.76

Radioactivity concentrations in water from rivers comparing to the background

locations	α	β	U	Th	^{226}Ra	^{210}Pb	^{210}Po
background	1	1	1	1	1	1	1
Reservoir 1	0.4	0.6	0.11	0.93	1.0	0.54	1.46
MT RV1 lower discharge point	8.0	7.2	26.8	5.29	64.6	18.73	14.66
MT RV1	6.4	4.6	12	2.96	31.1	6.48	11.55
NT RV2	2.2	2.6	11.8	1.36	1.27	1.49	9.48
SDQ RV3 lower discharge point	6.6	3.2	8.45	3.0	5.05	3.12	1.39
XH RV4	4.8	4.2	22.7	3.18	4.29	6.78	6.6
RV5 nearby a waste pile	10.80	7.80	138.6	0.71	1.4	0.3	1.46

locations	α (Bq/L)	β (Bq/L)	U (ug/L)	Th (ug/L)	^{226}Ra (mBq/L)	^{210}Pb (mBq/L)	^{210}Po (mBq/L)
background	0.05	0.05	0.44	0.28	3.08	7.78	1.26

4. Summary

(1) The activity concentrations of radionuclides of the coal, bottom ash and fly ash are higher than the radiation exemption level.

(2) A certain radiological impact on both the plant and the environment during mining and coal combustion. Radiation level enhanced because of waste spread and off gases.

(3) Indoor radon concentrations increased result from waste used as building materials in some extend.

Thank you for your attention!

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