Study of the phosphate industry in Belgium

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Phosphate industry

- 2 sulphuric acid :
  - disadvantage: phosphogypsum
- 1 hydrochloric acid :
  - less solid waste
- 1 nitric acid :
  - no measurements

Radon measurements

- Active and passive measurements in 3 firms
- On the plant and on the storage of the waste
- Radon concentration depends on the activity content of the raw materials
- Possible accumulation in the waste

Activity content (Bq/kg)

	Firm 1		Firm 2		Firm 3	
	Ore	Waste	Ore	Waste	Ore	Waste
^{226}Ra	32 ± 3	53 ± 8	64 ± 22 596 ± 71	161 ± 7	1095 ± 81	7320 ± 570
^{232}Th	78 ± 7	183 ± 38	204 ± 71 < 5	127 ± 12	9 ± 1	51 ± 13

Radon conc (Bq/m^3)

Working area	Firm 1	Firm 2	Firm 3
Storage of the ore	14 ± 5	84 ± 30	200 ± 20
Filter room	17 ± 6	31 ± 13	53 ± 5
Storage of the end product	10 ± 4	40 ± 28	35 ± 4
Dehydration room			550 ± 96
Storage of the waste	15 ± 5	55 ± 5	100 ± 15

Firm 1

- Soil gas measurements:
  - 10 - 40 kBq/m³
  - no enhanced values found
- Gamma-levels:
  - 50 - 100 nSv/h

Firm 2

- New storage place for phosphogypsum and the use of Kola ore (30 - 70 Bq/kg ^{226}Ra, 80 - 90 Bq/kg ^{232}Th)
- Radon measurements:
  - ranges from 9 to 18 Bq/m³
  - no difference covered or non-covered
- Gamma-level:
  - covered 80 nSv/h (normal value)
  - non covered 160 nSv/h

Firm 3

- Seasonal variations in dehydration building
- Enhanced ventilation necessary
- Enhanced gamma-activity
  - Dehydration building : 180 - 530 nSv/h
  - Storage waste : 2600 - 4400 nSv/h
- Liquid effluents (a.o. $CaCl_2$) dumped in nearby rivers

Investigation near the Ra-polluted rivers

- Soil gas-measurements
  - 10 m $\rightarrow$ 150 kBq/m^3
  - 40 m $\rightarrow$ 10 kBq/m^3 (normal)
- Gamma screening (3 km downstream from the effluents rejection point)
- Gamma spectrometric analysis of soil samples
- Chemical analysis of soil samples

Activity of soil samples

Distance to river (m)	^{226}Ra (Bq/kg)
1	3360 ± 100
5	1850 ± 30
10	640 ± 30
15	810 ± 30
25	200 ± 10

Depth profile of soil contamination

Depth (cm)	^{226}Ra (Bq/kg)
30	2000 ± 100
60	300 ± 20
100	20 ± 5

Chemical analysis

(mg/kg)	30 cm	60 cm	100 cm	Ref. levels
As	194	126	43	72
Cd	34	8	< 1	6
Cr	1260	174	637	179
Cu	107	68	47	281
Ni	800	155	1430	477
Pb	56	27	8	221
Zn	760	225	49	1326

Conclusions

- Enhanced values related to activity of the ore
- Gamma-levels
- Contamination of the surrounding
  - Leakage towards ground water
  - new building lots ?
- Combined chemical-radioactive study in progress
- Institutional control ??