Investigation of NORM in Ash Produced From Yatagan Coal-Fired Thermal Power Plants in Turkey

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Coal

- Burning coal in large combustion boilers to produce energy may contribute to enhance naturally occurring radioactive materials (NORM) in the environment.

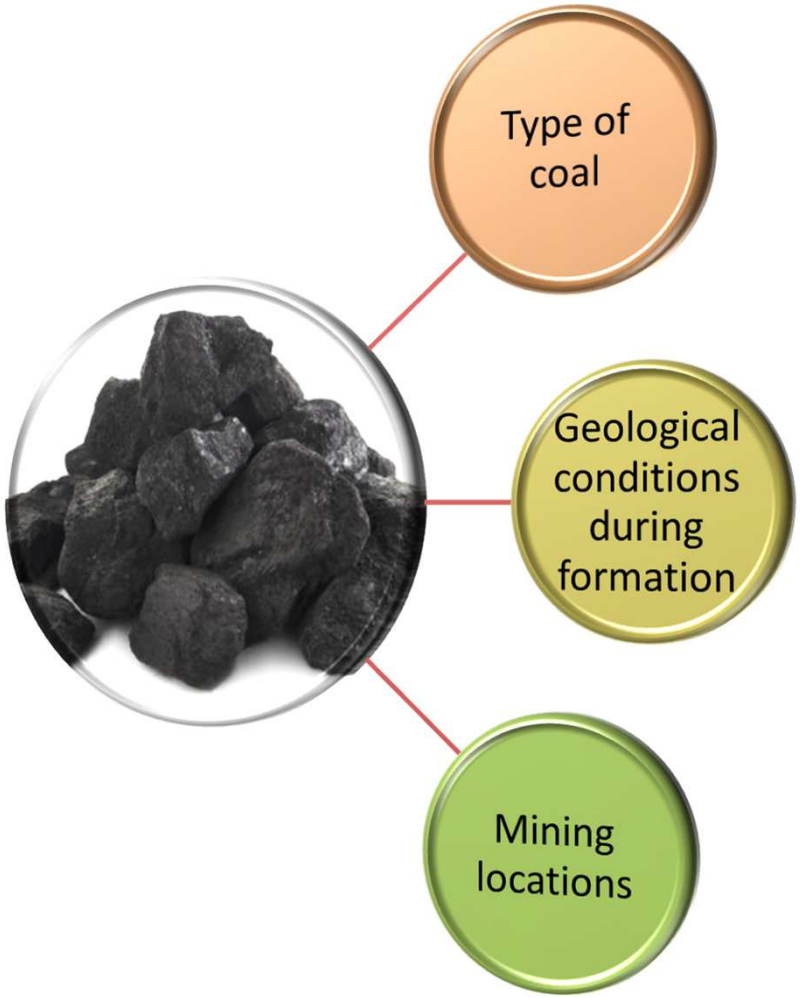
Coal

- Naturally occurring radionuclides such as ^{238}U, ^{226}Ra, ^{210}Pb, ^{232}Th and ^{40}K,
- Trace elements such as Cd, Cr, Pb, Ni and Zn.

Coal

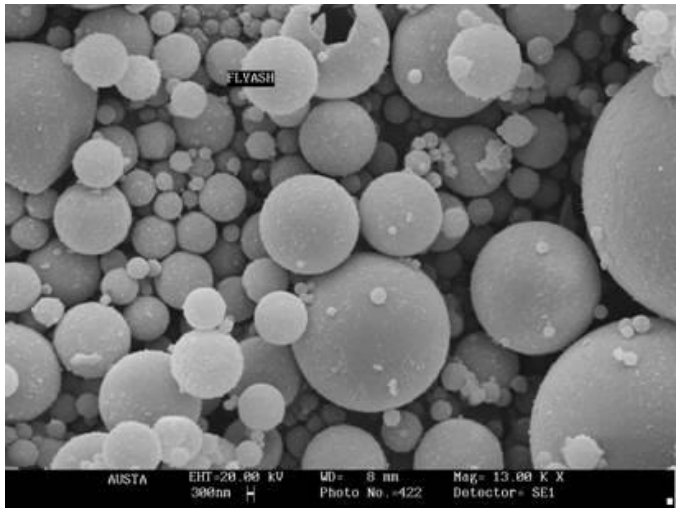
- Concentrations in coal,
- Ash content,
- Temperature of combustion and,
- Radionuclide partitioning between bottom ash and fly ash.

Concentrations in coal vary at large scale, depending on



Fly Ash

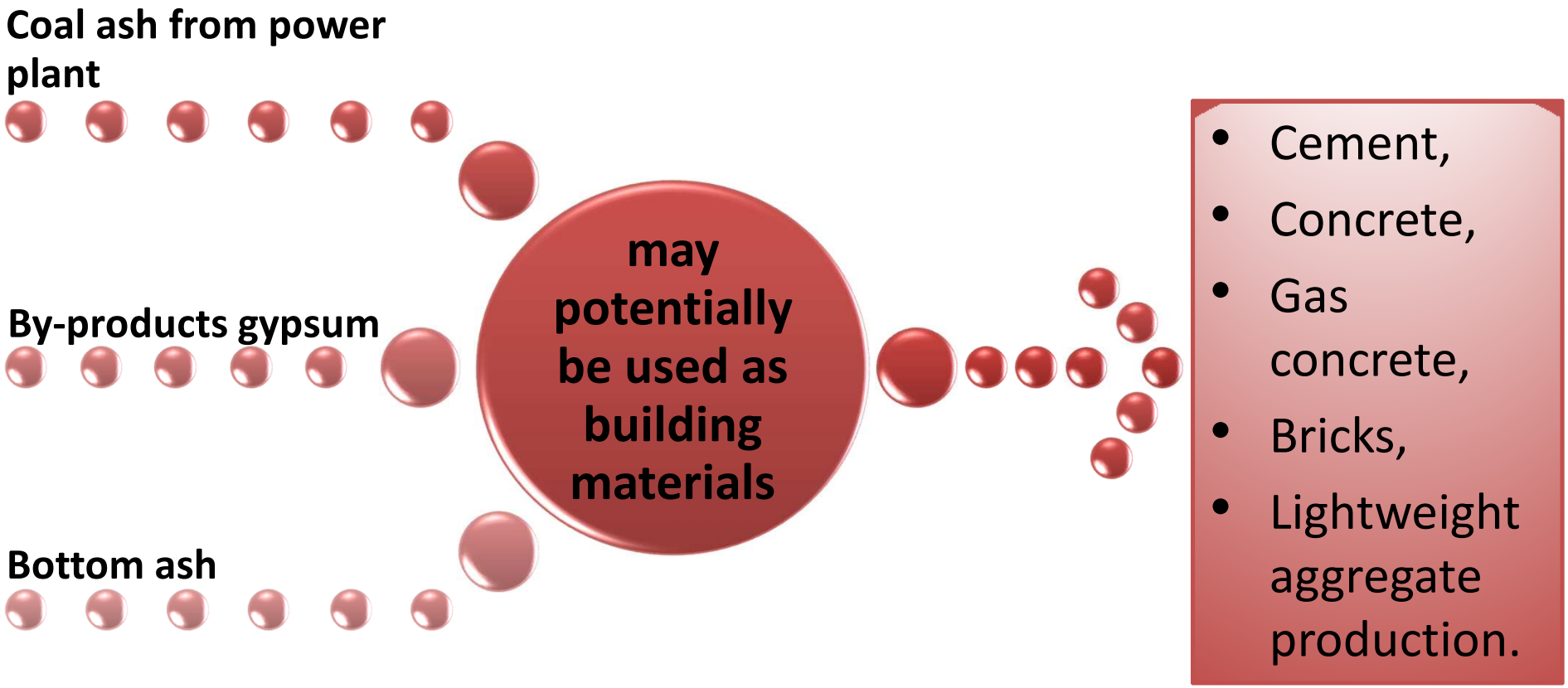
- produced as a product from industrial plants using pulverized coal or lignite,
- good structural qualities,
- contain heavy metals, volatile organic compounds, and radioactive solids.



http://www.flyashaustralia.com.au

Starting point

- The storage of waste resulting from the combustion of coal in thermal power plants leads to significant environmental problem.

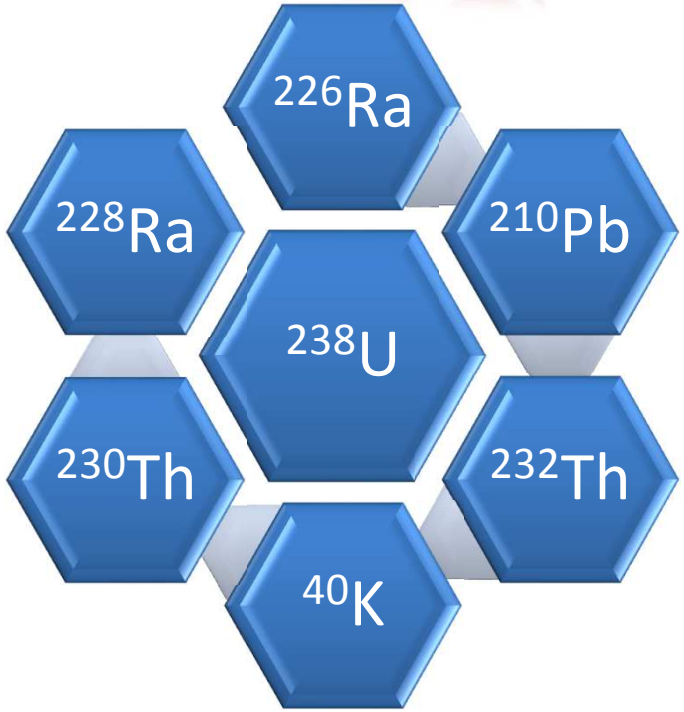

Coal ash from power plant
By-products gypsum
Bottom ash
may potentially be used as building materials
Cement,
Concrete,
Gas concrete,
Bricks,
Lightweight aggregate production.

Starting point

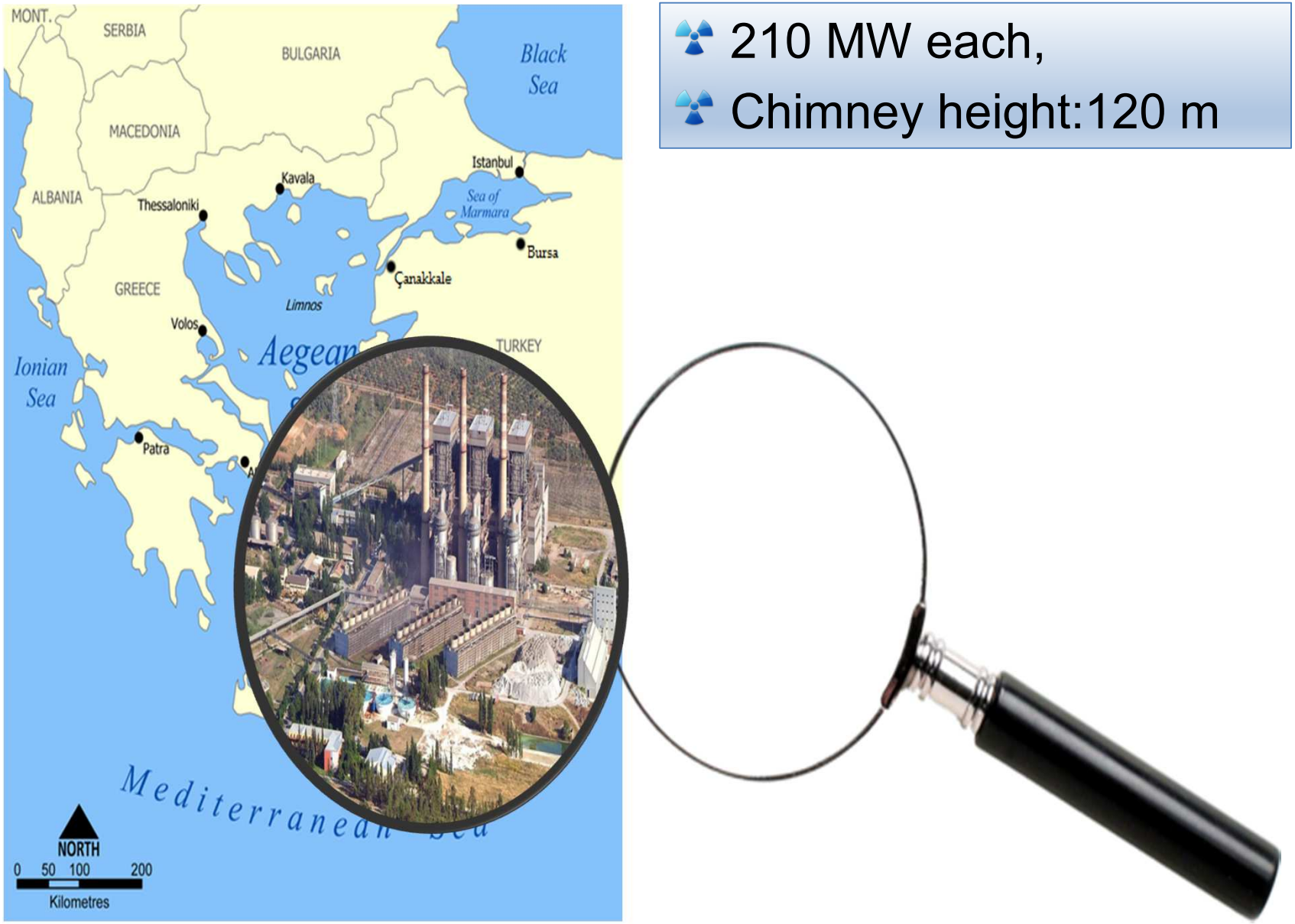
- The use of waste materials produced from coal-fired thermal power plants will have its advantages from the economical and the resource point of view.

Starting point

- to determine the naturally occurring radionuclides in the coal and the ash fractions, which were collected at different stage of the emission control system at the Yatagan thermal power plant.

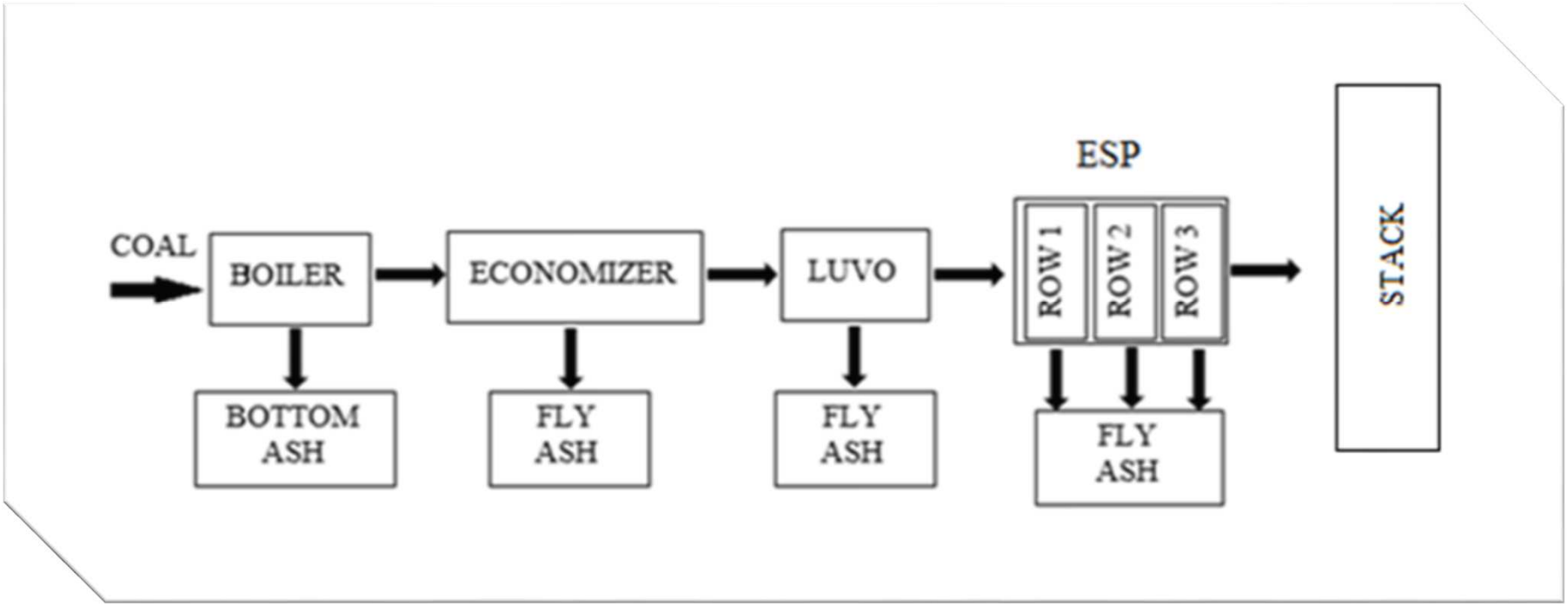


Sampling area



- 210 MW each,
- Chimney height:120 m

- The fractions of the combustion residues collected at different points following the pathway inside the power plant.

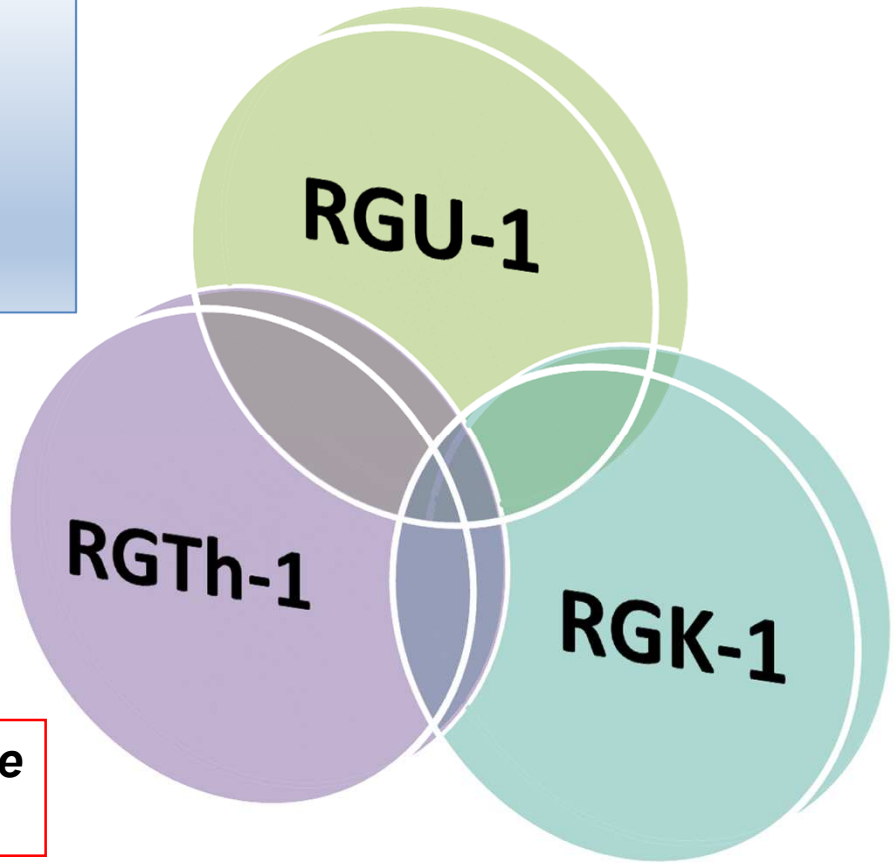

COAL
BOILER
ECONOMIZER
LUVO
ESP
ROW 1
ROW 2
ROW 3
STACK
BOTTOM ASH
FLY ASH
FLY ASH
FLY ASH

Analysis

- All samples were measured by gamma spectrometric techniques for the determination of ^{238}U, ^{226}Ra, ^{228}Ra, ^{210}Pb, ^{230}Th, ^{232}Th and ^{40}K.

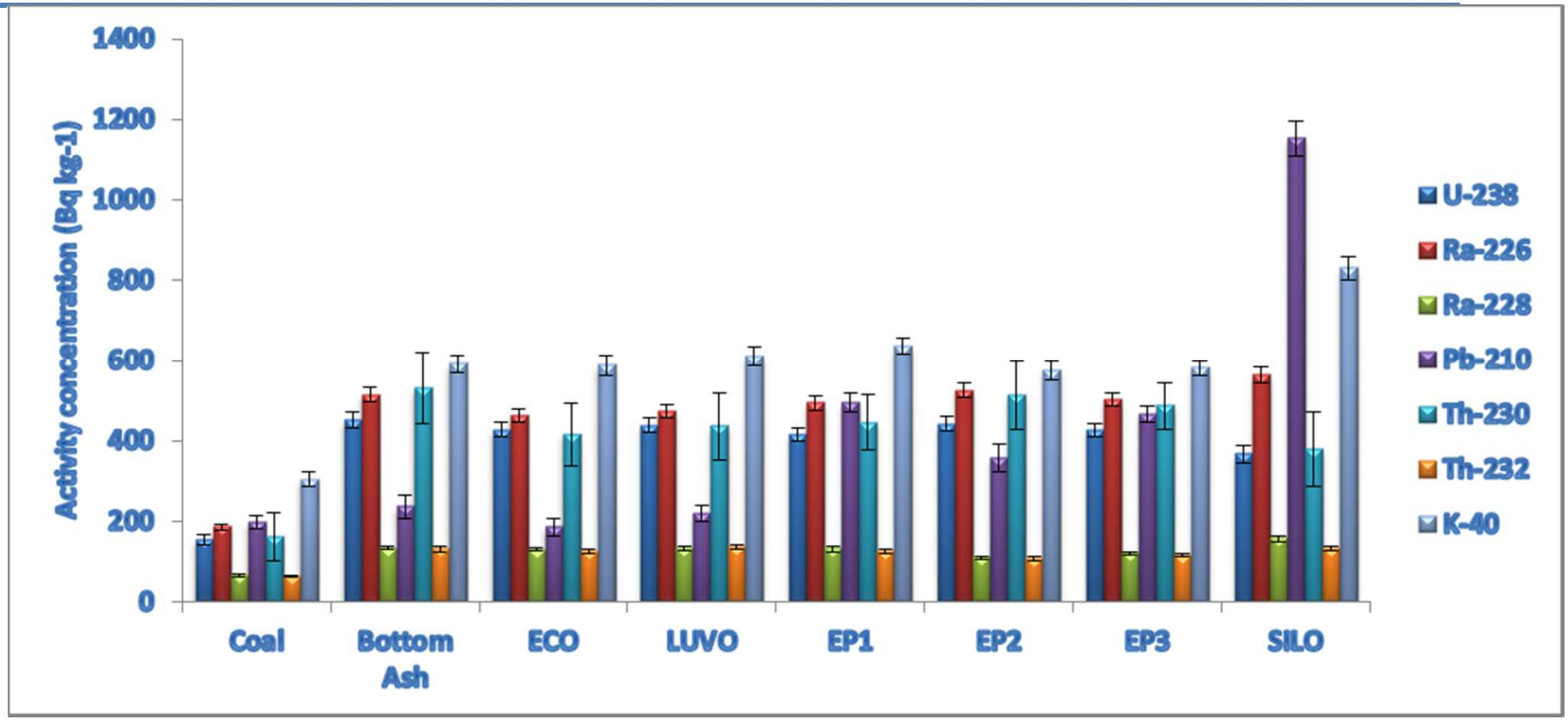
- The samples were placed into aluminium cases and dried at 105 °C for 24 hours.
- The sealed samples were stored for at least 23 days (6-7 half lives of ^{222}Rn) before gamma spectrometric measurements.

- Energy calibration,
- Efficiency calculations.



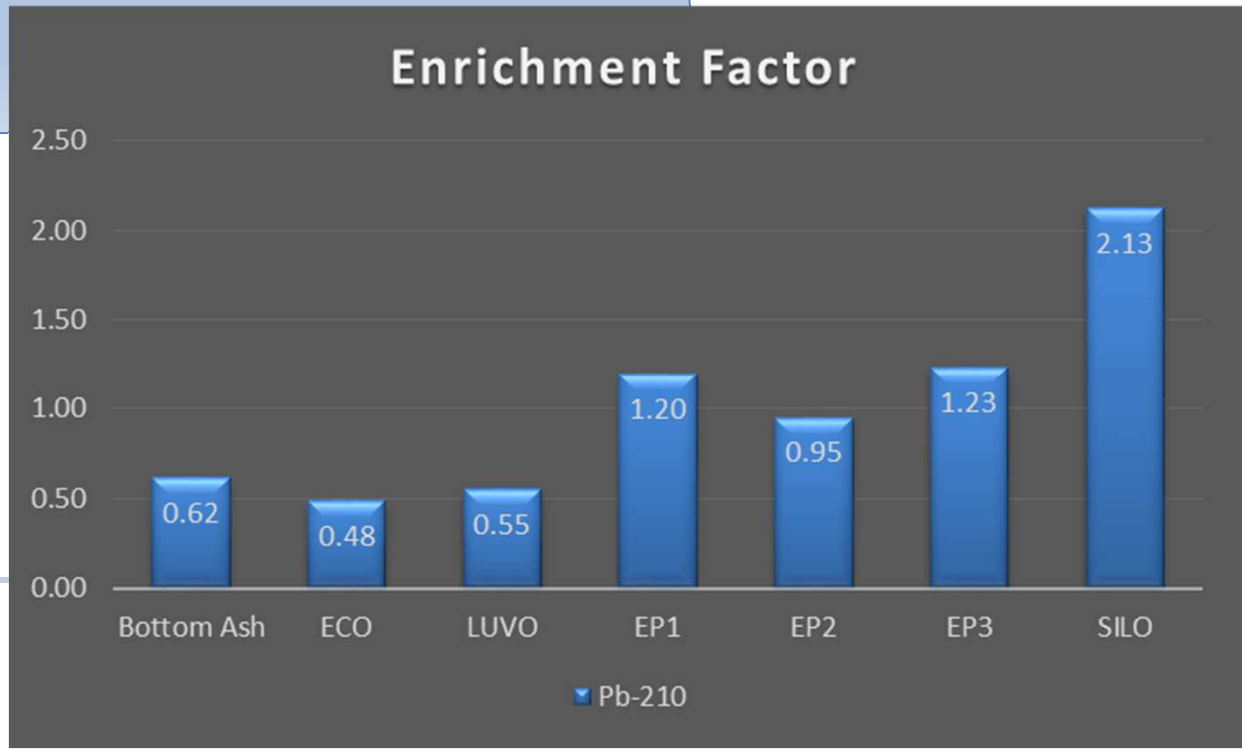
The sources are IAEA certified reference materials

Results

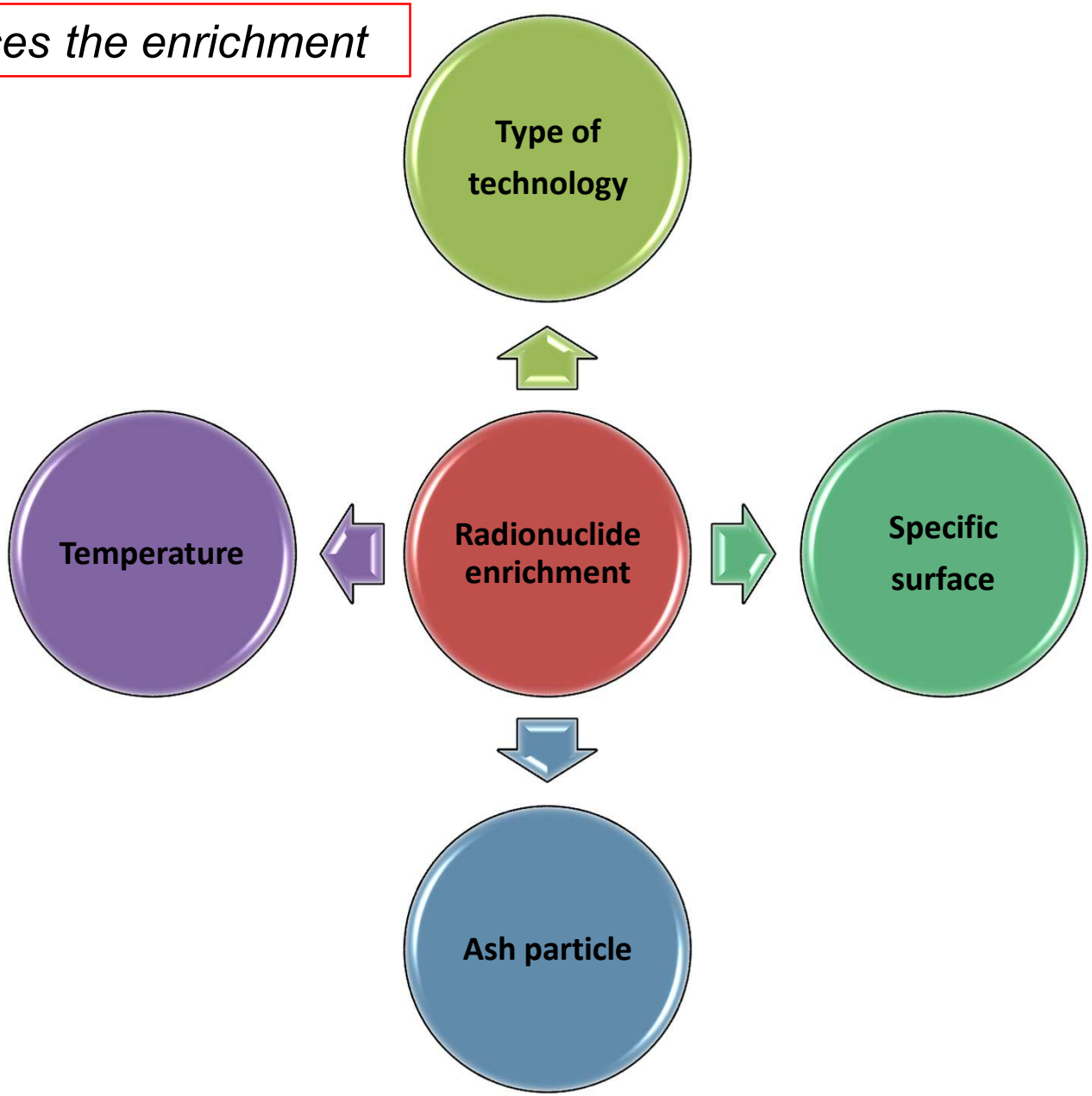

Activity concentration (Bq kg-1)
1400
1200
1000
800
600
400
200
0
Coal
Bottom Ash
ECO
LUVO
EP1
EP2
EP3
SILO
U-238
Ra-226
Ra-228
Pb-210
Th-230
Th-232
K-40

Radionuclide enrichment

- ^{210}Pb is generally more enhanced in the fly ash samples in the electrostatic precipitators of the plant because it's generally more volatile than other natural radionuclides.



What influences the enrichment



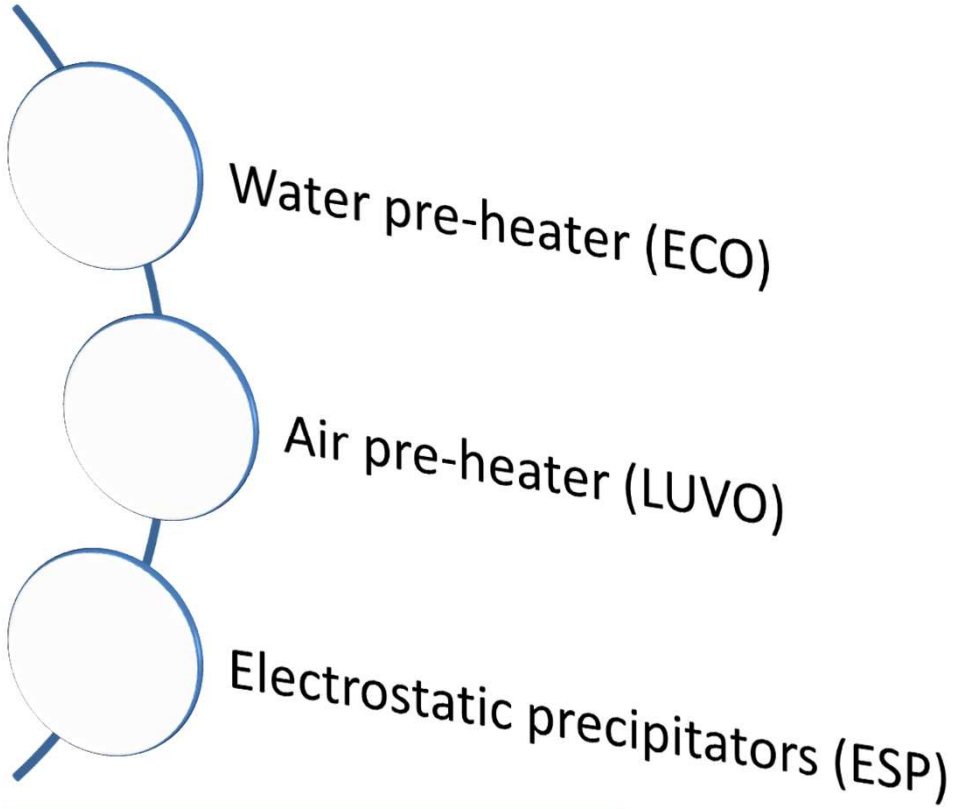
- Activity index (I) which was identified by the European Basic Safety Standards for controlling the radiological contribution of fly ash is used.

$$I = \frac{C_{Th}}{200} + \frac{C_{Ra}}{300} + \frac{C_K}{3000}$$

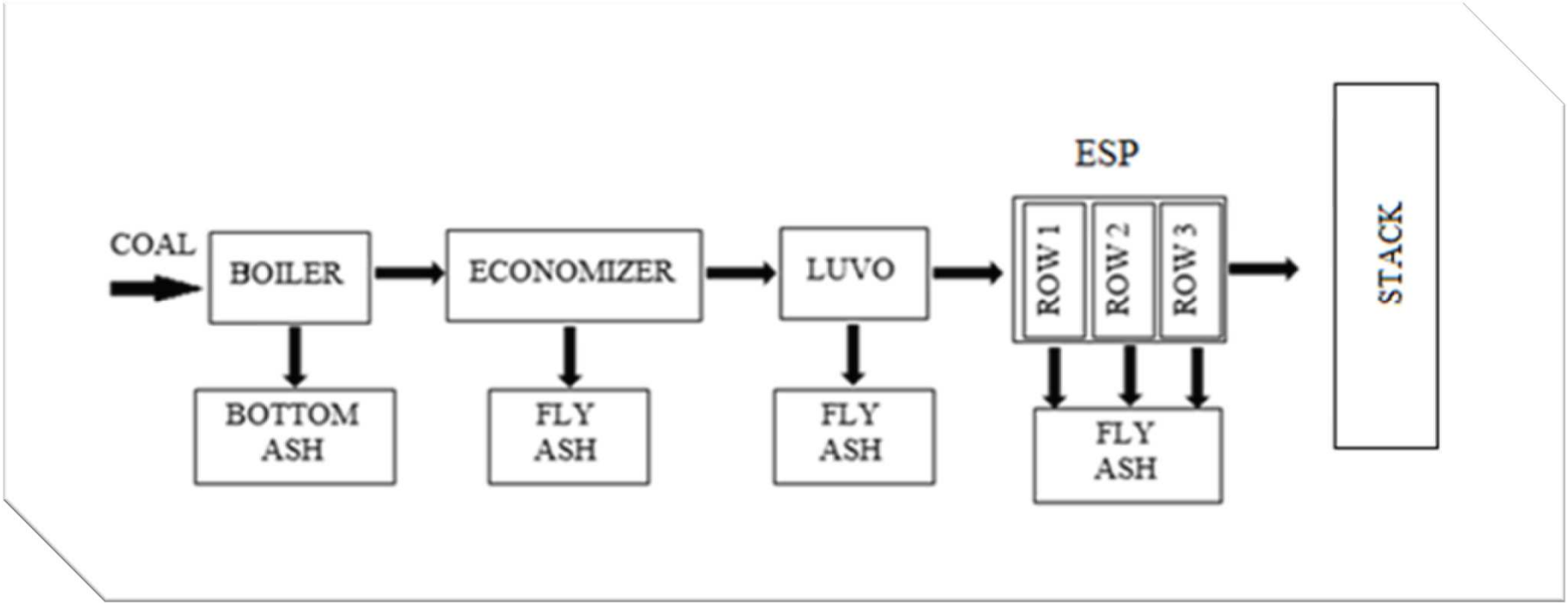
- The index is calculated taking into account the total effect of three main natural radionuclides which are radium (^{226}Ra) from the ^{238}U decay series, thorium (^{232}Th) from the ^{232}Th decay series and potassium (^{40}K).

$$I = \frac{C_{Th}}{200} + \frac{C_{Ra}}{300} + \frac{C_K}{3000}$$

- The activity index was calculated in all samples which are taken along the emission control system.



- The lowest activity index was found in the sample taken from the water pre-heater (ECO) point.



- assuming the utilization of fly ash as a cement additive at a proportion of 30%.

Conclusion

- In order to determine the potential risk due to fly ashes, a detailed investigation inside the power plant should be conducted.
- The radioactivity of the produced ashes depends on the point where the ash is collected inside the power plant.

Conclusion

- A careful selection of the fly ash collection point may result to the reduction of the possible health risk due to the fly ash radiological characteristics.
- If the building materials were to be prepared from the ashes at a proportion below 40%, the radiological issues can be ignored in terms of external gamma radiation.


Thank You!