Radioactivity in Minerals

Uranium and thorium were present with the other components of the Earth when it was originally formed. As molten rock cooled to form the Earth’s crust, these radioactive materials became trapped within the crystal structure of the rocks. The concentration of NORM in rocks varies according to local geology. The table below gives typical concentrations in some materials.

Detection and Measurement of NORM

To properly assess the potential radiation hazards from working with NORM it is necessary to know the concentration of radionuclides in both the uranium and thorium decay chains. This normally requires a laboratory analysis of a sample of the material. Suppliers of such materials should be able to provide this information.

External dose rate measurement

Although external dose rates are often below the levels at which control measures are required, they should be measured as part of routine monitoring in order to show where quantities of material are stored in bulk.

Dust measurement

Measurement of airborne dust concentrations is necessary in mining and other dust-intensive operations.

Radon measurement

Measurements over a three-month period can be made using passive radon gas monitors to provide an estimate of the average radon levels. However, care is needed to ensure that the ‘background’ radon from underlying rocks and building materials is considered separately. Where this is difficult, or where the average radon level is not representative of that during working hours, equipment that measures the short-term radon level may be more suitable.

Radon in the workplace

NORM may also produce the radioactive gas radon. Usually this is only a significant problem in workplaces with poor ventilation, such as in reaction vessels or other enclosed spaces.

Precautions and Procedures

External radiation

Dose rates from bulk quantities of minerals are normally low. Simple procedures, such as not storing minerals in regularly isolated areas, are usually sufficient to protect workers.

Internal radiation

Dust control systems should be considered, especially where the material is dry and fine particles are present. Where practical, engineering controls designed to prevent dust from entering the workplace should be used. In general, a factory with effective dust control will also be effectively controlling the hazards from inhaling NORM.

Worker protection

Respiratory protective equipment may be necessary in some circumstances. Normally this should be limited to short-term, well-defined tasks such as vessel entry or maintenance operations. Training in the selection, maintenance and wearing of such protective equipment is necessary for it to be effective.

Regulation of Work and Waste Disposal

The protection of people and the environment may require legal controls to be enforced through a system of regulations. As long as NORM is present throughout the natural environment, some situations will require control and some will not. So the use and disposal of some materials may be subject to regulation, as described below.

Worker protection

In the European Union, regulation of work with NORM depends on the radiation risk to individuals, rather than the radioactive content of the material. Specifically, regulations apply where annual radiation doses are likely to exceed 1 mSv. Elsewhere, a different regulatory system will often apply and the application to work with NORM should be checked with the relevant national authorities.

Environmental protection (waste disposal)

In the UK, certain materials containing natural radioactivity are exempted from the controls normally applied to the disposal of radioactive materials. For example, minerals such as zircon and ilmenite are usually exempt. However, to claim exemption, various conditions need to be met and expert advice should always be sought.

In the European Commission has recommended that the disposal of solid NORM waste may be exempted from regulatory controls if annual doses to individuals are below 0.3 mSv. Studies carried out in the UK and other countries on the disposal of typical solid NORM waste to well-managed landfill facilities have indicated that this condition can readily be met. Again national regulations for NORM waste disposal will vary, and the relevant national authorities should always be consulted.

Radiation Doses

In the UK, the average annual dose to a member of the public is 2.6 millisievert (mSv). Most of this is due to natural radiation. People working with NORM may receive an additional occupational dose, mostly from a combination of external gamma radiation and inhalation of dust.
