Chemistry - PI 24

ENVIRONMENTAL MONITORING - RADIOLOGICAL EMISSION MEASUREMENT

Objective:

1. For each of the categories (see Module 51-1) for which there is a DEL, describe in a sentence or two how the actual value of the quantity released is measured.

Radiological emissions are monitored for three reasons:

(a) **Compliance** - to ensure that quantities released are within legislated release limits.

(b) **NGD Targets** - to see that quantities released do not exceed NGD in-house target limits.

(c) **Control** - to detect gross malfunction of radioactive systems.

This module will give you a general outline of the methods used to gather data to check on compliance and target performance. You will recall that the categories for which we have Derived Emission Limits are:

(a)	Airborne	(i)	Tritium
		(ii)	Noble Gases
		(iii)	Iodine-131
		(iv)	Particulates
(b)	Liquid	(i)	Tritium
		(ii)	gross β, γ .

The general methods for the measurement of radiological emissions are outlined on the following pages.

A) Airborne

(i) Tritium - a sample of stack air is extracted and the moisture, containing the Tritium is removed, the removed moisture may then be analyzed by liquid scintillation for Tritium. Knowing the stack flow and the sample volume, one would then be able to calculate Tritium flow up the stack.

The moisture may be removed from the stack air sample by one of several methods, the more common ones are;

(a) **Cold Finger** - this is a collection chamber chilled by liquid air on the outside and through which the stack gas sample is passed. Condensation of water vapour at that temperature is virtually total.

(b) **Silica Gel** - the stack gas sample is passed through a "filter column" packed with silica gel a substance which is highly hygroscopic (absorbs water). Once again virtually all of the water vapour is removed from the sample of stack gas.

(c) **Bubbler** - the stack gas sample is bubbled through a canister of light water. Any tritiated moisture will preferentially remain in the liquid phase which would later be analyzed. (Bubbler operation is outlined in the Radiation Protection Training course).

(ii) Noble Gases

As noble gases are an external hazard only the energy emitted due to noble gases is the required measurement, hence the units for noble gas emission: γ - Ci-MEV.

A sample of stack gas is passed through an integrating gamma count meter which is shielded from beta. The meter is calibrated using a mixture of noble gases which from historical analyses would be typical of that plant. Knowing the number of counts read by the meter for a sample of known γ - Ci-MEV, one could then determine the noble gas emission in the stack by the meter count during operation.

(iii) Iodine-131 - a sample of stack gas is passed through a charcoal filter. All of the Iodine adsorbed onto the charcoal and the filter may then be inserted into a pulse height analyzer to determine Iodine-131 content. Sample flow/stack flow comparisons will yield stack emissions.

(iv) Particulate - a sample of stack gas is passed through an absolute filter which for all practical purposes traps all the particulate matter in the sample. The filter is then analyzed for radioactive particulates by a gross β, γ counter.

A fifth item will soon be added to radio-emissions from stack which is Carbon-14. The proposal for analysis is to pass a sample of stack gas through a bubbler containing a solution of Sodium Hydroxide which will absorb the CO_2 and CO, the major forms of Carbon emission. The liquid in the bubbler may then be analyzed by a liquid scintillation method for C-14.

B) Liquid

(i) Tritium - samples of liquid effluent from the station are gathered and analyzed specifically for Tritium by liquid scintillation. There are also in line Tritium monitors for "control" purposes.

(ii) Gross β, γ - once again samples are taken and merely counted for β, γ. (The DEL for gross β, γ is based on the most restrictive radio-nuclides in liquid effluent, Sr-90 and I-131).

As for airborne emissions, C-14 will soon be added to the liquid emission list. Samples of liquid effluent could be analyzed quite easily by liquid scintillation for C-14.

The data presented in this module is meant to give you a general, basic idea of the methods used to determine performance against targets for radiological emissions. Exact methods vary from station to station and will not be discussed here.

Here's What To Do:

1. As good practice for Module 51-1 list the items which have radiological DEL and for this module pencil in (in point form) the method of analysis. Check your work against the notes or with a colleague.

2. If you have any questions, see the Course Manager - otherwise it's on to the next module.

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