

Procedure for determining higher concentrations of radionuclides in samples of animal feeds by gamma spectrometry

F- γ -SPEKT-FUMI-02

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Procedure for determining higher concentrations of radionuclides in samples of animal feeds by gamma spectrometry

1 Scope

This procedure is to be applied when elevated activities have been deposited following nuclear weapons tests or an accident at a nuclear installation that may lead to highly contaminated animal feeds. The gamma-spectrometric measurements are intended to rapidly provide an overview of the type, severity and extent of the contamination of those animal feeds in particular that grow above ground and are at a growth stage where they will soon be harvested for the purpose of feeding animals or manufacturing animal feeds for storage.

In contrast to procedure F- γ -SPEKT-FUMI-01, a number of simplifications are introduced with regard to sampling, preparation of samples, and analysis to facilitate a rapid sample turnover. Larger errors are deliberately accepted here.

2 Sampling

Collecting and processing samples with elevated activity concentrations requires increased caution to prevent contamination of laboratories and measuring instruments.

Cutting or picking sample vegetation should only be done wearing one-way gloves. Contaminating the outer sides of the sample bags must be avoided as far as possible. Other than that, the guidelines for sampling largely agree with the procedures described in procedure F- γ -SPEKT-FUMI-01.

2.1 Vegetation of pastures and meadows (clover, lucerne, green cereals)

The selected sampling areas need to be in the range of 0,1 ha to 1,0 ha. It is expedient to cut off the vegetation in several sample spots measuring 70 cm² x 70 cm² (= 0,5 m²) close to the ground (using, e. g., grass shears), then combine it to a mixed sample of 5 kg to 10 kg in a plastic bag. Contamination with soil and roots is to be avoided.

2.2 Maize (whole plants)

In a maize field of 0,1 ha to 1 ha in area, one plant each is cut off some 5 cm above the ground at altogether 5 spots that are distributed evenly over the sampling area. The sampled plants are combined, roughly chopped up and transported in plastic bags.

2.3 Feedgrain

A total of ten subsamples are collected from the combine harvester, transport vehicle or granary of the farmer during or after harvesting and combined to form a mixed sample of 2 kg.

3 Analysis

3.1 Principle of the procedure

The sample material is chopped up roughly and measured by gamma spectrometry in this form.

3.2 Sample preparation

In the case of elevated activities, the samples must be prepared outside the measuring laboratory to avoid contaminating equipment and measuring instruments. Staff must wear one-way gloves while processing the samples.

Contaminating the outside faces of measuring vessels must be avoided at all costs. Measuring vessels may not be reused under these circumstances.

3.2.1 Vegetation of pastures and meadows (clover, lucerne, green cereals)

The plant material is simply cut up with a pair of scissors or shredded in a shredder to fragments of 2 cm to 3 cm in length, mixed thoroughly by hand, and then compacted as densely as possible in a 1 l-Marinelli beaker or 1 l-bottle with a screw-cap.

3.2.2 Maize (whole plants)

The whole sample is shredded as finely as possible to disintegrate the plant parts which are then mixed thoroughly by hand, and compacted as densely as possible in a 1 l-Marinelli beaker or 1 l-bottle with a screw-cap.

3.2.3 Feedgrain

The whole sample mixed thoroughly and filled in measuring vessels of 1 l.

3.3 Radiochemical separation

No radiochemical separation is required.

4 Measuring the activity

Basic information on, and aids for, gamma spectrometry are contained in chapters IV.1.1 through IV.1.3 of this procedures manual.

The gamma spectra are measured with a Ge-spectrometer (> 15 % efficiency relative to a 3" x 3" NaI(Tl)-detector for the 1,33 MeV line of Co-60) in 1 l-Marinelli beakers or screw-capped bottles of volume 1 l.

The procedures to be applied for quantitatively calibrating a gamma spectrometer are outlined in detail in procedure F- γ -SPEKT-MILCH-01.

5 Calculation of the results

High-performance PC software for the analysis of gamma spectra is available from a number of software suppliers. Preference should be given to software that not only makes provision for calculating the specific activities of all major radionuclides, but can also calculate decision thresholds and detection limits according to chapter IV.5 of this procedures manual and employ the decision threshold as a criterion in the search algorithms to decide whether or not a line is distinct from the background.

In the case of elevated contamination levels it is essential that the laboratory be equipped with fully automated analysis facilities for gamma spectra, as large numbers of samples need to be processed rapidly. Programming and using so-called macros can effectively automate analyses up to printing out the results; these possibilities are part and parcel of most software products.

The radionuclide specific activities or the detection limits are always to be reported in Bq·kg⁻¹ DM (dry mass). As circumstances would not normally allow for determining water contents and dry mass, respectively, conversions into dry mass can be based upon the following average values, which are adopted from the tables of animal feeds published by the Deutsche Landwirtschaftsgesellschaft (DLG e.V.):

Tab. 1: Average values of dry mass of animal feeds to be monitored in %

Animal feed	Dry mass
<i>Pasture vegetation (extensively used pasture)</i>	
1 st growth stage, prior to producing ears/panicles	17,0
1 st growth stage, while producing ears/panicles	18,5
1 st growth stage, beginning to peak of flowering	22,0
1 st growth stage, end of flowering	24,0
2 nd and further growth stages, less than 4 weeks	17,0
2 nd and further growth stages, 4-6 weeks	20,0
2 nd and further growth stages, more than 6 weeks	23,0
<i>Pasture vegetation (intensively used/mowed pasture)</i>	
1 st growth stage, prior to producing ears/panicles	16,0
1 st growth stage, while producing ears/panicles	17,5
1 st growth stage, beginning to peak of flowering	22,0
1 st growth stage, end of flowering	24,0
2 nd and further growth stages, less than 4 weeks	16,0
2 nd and further growth stages, 4-6 weeks	18,0
2 nd and further growth stages, more than 6 weeks	20,0
<i>Pasture vegetation, rich in grass</i>	
1 st cut, prior to producing ears/panicles	17,0
1 st cut, while producing ears/panicles	18,0
1 st cut, beginning to peak of flowering	21,0
1 st cut, end of flowering	23,0
2 nd and further cuts, less than 4 weeks	18,0
2 nd and further cuts, 4-6 weeks	20,0
2 nd and further cuts, more than 6 weeks	22,0
<i>Red clover</i>	
1 st cut, prior to budding	19,1
1 st cut, while budding	20,7
1 st cut, beginning to peak of flowering	22,0

Version September 1992

Animal feed	Dry mass
1 st cut, end of flowering	23,5
2 nd and further cuts, prior to budding	18,7
2 nd and further cuts, during budding	20,0
2 nd and further cuts, beginning to peak of flowering	22,0
<i>White clover</i>	
1 st cut, prior to budding	12,0
1 st cut, while budding	13,0
1 st cut, beginning to peak of flowering	14,0
1 st cut, end of flowering	17,0
<i>Lucerne</i>	
1 st cut, prior to budding	17,6
1 st cut, while budding	19,3
1 st cut, beginning to peak of flowering	21,0
1 st cut, end of flowering	24,0
2 nd and further cuts, prior to budding	20,3
2 nd and further cuts, during budding	22,0
2 nd and further cuts beginning to peak of flowering	23,0
<i>Green oats</i>	
prior to producing panicles	15,0
while producing panicles	16,4
while flowering	21,1
while at milk stage	26,4
<i>Green rye</i>	
prior to producing ears	15,7
while producing ears	17,3
while flowering	17,9
while at milk stage	18,9
<i>Maize, whole plant</i>	
beginning of cobbing	16,0
while at milk stage	22,0
while at dough stage	27,0
end of dough stage	32,0
<i>Feeder cereals</i>	
Summer barley	87,0
Winter barley	88,0
Oats	88,4
Maize	87,9
Rye	87,1
Summer wheat	86,7
Winter wheat	87,6

6 Characteristic limits of the procedure

The information provided in section 6 of procedure F- γ -SPEKT-FUMI-01 applies analogously.

7 Catalogue of chemicals and equipment

7.1 Chemicals

No chemicals are required.

7.2 Equipment

The required equipment is listed in procedures F- γ -SPEKT-MILCH-01 and F- γ -SPEKT-FUMI-01.