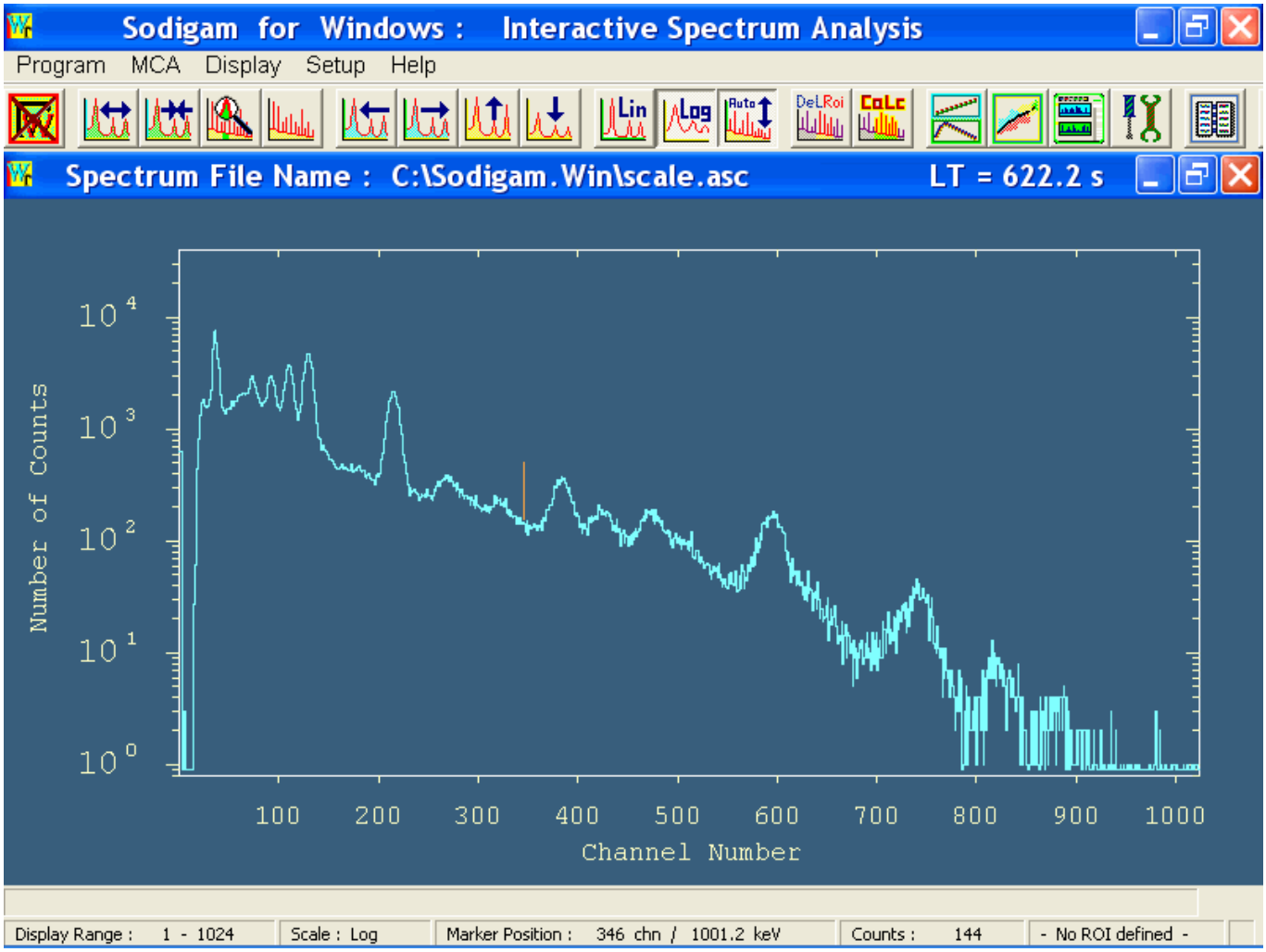
Dr. Westmeier GmbH
Möllner Weg 5
D-35085 Ebsdorfergrund-Mölln
Telephone +49 (0) 6424-923000 • Fax +49 (0) 6424-923002 • westmeier@westmeier.com

Measurement of NORM (scales) from the oil- and gas-industry

Relevant measurements of scales in tubings, valves and other contaminated components in the oil- and gas-industry can be made using portable gamma-ray spectrometers with NaI(Tl) or other room-temperature scintillation detectors, Material from wet or dried lagoons containing "produced water" from drilling rigs can also be surveyed. Spectra are analysed on-line with SODIGAM yielding nuclide-specific contamination information that will serve for immediate and well-founded ad-hoc decisions how to proceed.
Using specific batch-files one can precisely and fast analyse peaks from any nuclide in the spectrum.
An example of a measurement of scales in tubings from a Libyan oil rig is shown below.



Spectrum from scales containing almost no thorium

Using fully automatic batch-file operation, several regions of the spectrum containing relevant peaks from Uranium and Thorium are analysed using SODIGAM.
This sample does not contain significant amounts of thorium. From the most clearly distinguished Th-peak at 2614 keV (approx. channel 880), the Th-contents is calculated as only 35.7± 5.0 Bq/kg.

Moreover one does not find Uranium in the scales spectrum!! but only peaks from its progeny after ^{226}Ra. The position of the strongest "uranium" peak at 1001 keV (this peak actually comes from ^{234m}Pa) is indicated in the spectrum with the brown marker line. .
The result of the quantitative SODIGAM spectrum analysis and nuclide assignment is shown below:

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Peak Assignments:
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Library :  E:\winTMCA32_scintiSPEC\Sodigam.Win\Library\scale.lib
Spectrum : E:\winTMCA32_scintiSPEC\Sodigam.win\Spectra\scale.asc
Sample =  1000.000 grams    measured for  622 seconds    ± = 0.0 keV


Ra-226   / 1600.0 Y/  Energy  E-Lit.  Ig/%           Bq/kg
                      185.9   186.0    3.59     1635.3 ±     141.5
                     ============================================
Average activity from clear lines ( 1)          1635.3 ±     141.5


Rn-222   / 1600.0 Y/  Energy  E-Lit.  Ig/%           Bq/kg
                      609.3   609.3   46.10     1312.6 ±      76.9
                      353.5   351.9   37.10     1698.0 ±     100.6
                      294.9   295.2   19.20     1847.7 ±     124.4
                     1752.2  1764.5   15.90     1667.2 ±     121.9
                     1117.2  1120.3   15.00     1656.1 ±     116.6
                     1228.9  1238.1    5.92     1728.4 ±     187.0
                     2197.4  2204.1    4.99     1514.9 ±     159.0
                      768.9   768.4    4.88     1106.5 ±     167.9
                     ============================================
Average activity from clear lines (8)           1545.5 ±      81.9
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The activity of ^{222}Rn and progeny is somewhat lower than the ^{226}Ra activity because part of the noble gas ^{222}Rn is released in the decay of ^{226}Ra by alpha-recoil and due to its long half-life it can emanate from the sample.
Despite the short measuring time of only 622 seconds the SODIGAM analysis of the scales spectrum yields remarkably precise results which agree within uncertainties with HPGe spectrometry of the same sample.
Quotients of analysed results from ^{222}Rn / ^{226}Ra activities measured with different gamma-ray spectrometers are as follows: HPGe detector: 0.9118 ± 0.0807
NaI(Tl) detector: 0.9451 ± 0.0960
i.e., around 6% to 9% of radon progeny emanate from the scales material.