Executive Summary

The 3-year Research Project MetroRADON (Metrology for Radon Monitoring) started in June 2017 and is funded within the European Metrology Programme for Innovation and Research (EMPIR). The purpose of the project is to develop reliable techniques and methodologies to enable SI traceable radon activity concentration measurements. More information can be found on the MetroRADON website.

Due to the relevance and topicality of the subject, the consortium of 17 partners from National Metrology Institutes and research institutes was expanded with currently seven official collaborating institutions and an Industry Interest Group of 26 companies was initiated. In addition, co-operations with existing networks and research programmes were established. The high interest in collaboration and in the topics of MetroRADON confirms the importance of the project for a variety of European stakeholders in the field of radon. First results were presented at several conferences all over Europe and are available as reports on the MetroRADON website.

This newsletter highlights some actions from the first half of the project and lists some of the dissemination activities. Details of the project tasks and first results are discussed in the "Status Report" that can also be found on the website. All the mentioned material is available on the Document section of the MetroRADON website and directly linked in this newsletter.

If you are interested in collaborating with MetroRADON or want to join the Industry Interest Group, please contact us!

Contact

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MetroRADON Partnership

BEV-PTP: Physikalisch-Technischer Prüfdienst des Bundesamts für Eich- und Vermessungswesen, Austria (coordinator)

BFKH: Budapest Főváros Kormányhivatala, Hungary

CEA: Commissariat à l'énergie atomique et aux énergies alternatives, France

CMI: Cesky Metrologicky Institut, Czech Republic

IFIN-HH: Institutul National de Cercetare-Dezvoltare pentru Fizica si Inginerie Nucleara "Horia Hulubei", Romania

PTB: Physikalisch-Technische Bundesanstalt, Germany

STUK: Sateilyturvakeskus, Finland

VINS: Institut Za Nuklearne Nauke Vinca, Serbia

AGES: Österreichische Agentur für Gesundheit und Ernährungssicherheit, Austria

BfS: Bundesamt für Strahlenschutz, Germany

CLOR: Centralne Laboratorium Ochrony Radiologicznej, Poland

IRSN: Institut de Radioprotection et de Surete Nucleaire, France

JRC: Joint Research Centre - European Commission, Europe

SUJCHBO: Státní ústav jaderné, chemické a biologické ochrany, v.v.i., Czech Republic

SUBG: Sofiiski Universitet Sveti Kliment Ohridski, Bulgaria

UC: Universidad de Cantabria, Spain

METAS: Eidgenössisches Institut für Metrologie, Switzerland

MetroRADON collaborators

DiMEILA Centro Ricerche INAIL, Italy

EURADOS, international

Istituto Superiore di Sanità, Italy

Radonova, Sweden

University of Babeș-Bolyai, Romania

Universidade de Coimbra, Portugal

University of Novi Sad, Serbia

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HIGHLIGHTS

Overview of indoor radon surveys in Europe: Report available!

A new report on the literature review of indoor radon surveys in Europe conducted within MetroRADON has been published online as a JRC Technical Report (Joint Research Centre of the European Commission)!

The aim of this report is to provide an overview of existing indoor radon surveys in Europe. Different steps of the "survey chain", e.g. from survey design through sampling, measurements to evaluation, and interpretation, that yield an output have been explored. Journal papers and papers in international and national conference proceedings were reviewed, resulting in data collected from 45 countries. The information contained in the report should serve as an input to propose approaches to reduce inconsistencies and improve harmonization of indoor radon data.

PANTELIĆ G, ČELIKOVIĆ I, ŽIVANOVIĆ M, VUKANAC I, NIKOLIĆ JK, CINELLI G, GRUBER V, Literature review of Indoor radon surveys in Europe, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97643-8 (online), doi:10.2760/977726 (online), JRC114370

Field radon intercomparison exercise

An intercomparison exercise for active and passive radon monitors for variable indoor and outdoor conditions and ambient parameters has been carried out between 5th – 8th November 2018 (Fig. 1).

The exercise has been organized by the University of Cantabria (Spain) in the laboratory of Natural Radioactivity (LNR), located at the facilities of a former uranium mine (Ciudad Rodrigo, Salamanca, Spain). The maximum number of 20 participants was reached, which shows the great interest from the radon community. The activities have been focused on radon exposure in air for passive and active monitors with two levels of exposure, radon in soil and radon exhalation from soil. At the moment, the results are being analysed and a report will be available on the MetroRADON website soon.

Announcement: Comparison of existing radon gas primary standards according to CCRI(II) rules

The last comparison of radon activity concentration under the auspices of CCRI[1] was undertaken in Europe in the early 2000s and the data is more than 10 years old. Within the framework of MetroRADON two new comparisons of National Metrology Institutes (NMI)/Designated Institutes (DI) capabilities for ^{222}Rn and ^{220}Rn in the range of a few kBq will be undertaken to assure the quality of these calibration facilities.

If you are interested in participating, please contact us until end of February 2019!

[1] Consultative Committee for Ionising Radiation, Section II: Measurement of radionuclides, BIPM, Sèvres, France

Fig. 1: Impressions of the radon intercomparison exercise at the LNR, Ciudad Rodrigo, Spain

Development of new radon and thoron sources

One aim of MetroRADON is to develop novel procedures for the traceable calibration of radon measurement instruments at low activity concentration with relative uncertainties below 5 %. To achieve this goal development of reference ^{222}Rn and ^{220}Rn sources with constant, stable emanations and activity traceable to primary standards is necessary. Emanation sources are developed and tested within the project utilizing different methodologies (electrodeposition, implantation, chemisorption, drop deposition, precipitation techniques).

The testing of the production of ^{222}Rn sources by chemisorption was promising, but it is necessary to precisely control temperature to achieve homogeneous activity distribution throughout the source. Long-term stability will be checked over the course of the project because radon can diffuse through the polymer.

A process for production of ^{222}Rn sources by implantation of ^{226}Ra into W and Al targets was successfully developed and tested. The implanted sources show no dependency of ^{222}Rn progeny count rates on humidity, but emanation powers of the sources are rather low in comparison to the electrodeposited sources. ^{226}Ra and ^{228}Th solutions were used to prepare a ^{222}Rn and ^{220}Rn emanation sources with a relative standard uncertainty of 2 % by precipitation techniques. A preliminary study shows no dependence of the average count rates on humidity, temperature and pressure.

Additionally, a long-term stable low-level flow through ^{222}Rn source of 5 kBq ± 1 % with a defined activity concentration in the gas phase was developed and tested. The design consists of a thin layer of silicon foil in which ^{226}Ra is embedded. A high emanation power of 0.998 ± 1 % has been achieved. At a maximum flow rate of 10 L/min a radon output of 38 Bq/hour can be accomplished. After a sufficient waiting period a stable ^{222}Rn atmosphere can be achieved.

Development of calibration procedures at low activity concentration

A facility for the realization and dissemination of the measurement quantity radon activity concentration has been set up. The basic component of the facility is a radon-tight chamber with a certified volume traced back to a standard volume at PTB. The facility is equipped with instruments for monitoring temperature and air pressure. This basic setup is extended by an additional volume as well as by devices for online-monitoring of the actual radon activity concentration and for extraction of a defined quantity of radon-loaded air. As the facility uses emanation sources releasing a constant radon activity, a constant radon activity concentration establishes inside the calibration chamber over time. An emanation source developed within the project was installed in the chamber. By applying an air flow through the source, the released radon is conveyed into the calibration volume. The same air flow is diverted from the chamber. The chamber operates in an open mode, where the activity concentration inside depends on the radium activity, the emanation rate as well as the volume flow of air. Since radium activity and radon emanation rate are intrinsic characteristics of the source, the level of the radon activity concentration can be controlled by the volume flow. Fig. 2 shows the radon activity concentration established inside the calibration chamber at a volume flow of about 2.1 L/min.

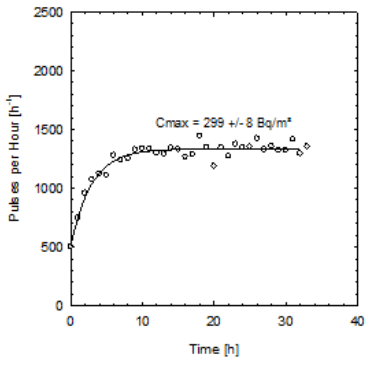

Fig. 2: Buildup of a constant radon activity concentration inside the calibration chamber

^{220}Rn calibration activities and ^{220}Rn barriers testing

A thoron calibration exercise has been carried out using the large exposure chamber BACCARA at IRSN. Seven monitors of MetroRADON partners that will serve as reference instruments in their future experiments were calibrated against the existing primary thoron measurement system. Two methods (by LSC and SSNTDs) to check thoron homogeneity in the reference chamber under different circumstances were developed, tested and used in the calibration exercise.

Materials that are promising as thoron barriers have been identified and tested under variable climate conditions. The coefficient of diffusion and the solubility of radon were determined for four types of polymer foils, suitable for the usage as thoron barriers, at temperatures between 5° C and 20° C. Experiments (at room temperature) are ongoing with ten other polymer materials.

New method for estimation of radon priority areas

The method of retrospective radon measurement using CDs and DVDs has been evaluated for its ability to serve as a predictor of radon priority areas. A novel version of the CD/DVD method of enhanced sensitivity has been developed, using a radon absorber/radiator of very high radon absorption ability in contact to the surface of CD/DVDs as detectors of large total detection area (Fig. 3). The novel method can be used for low radon concentration measurements as well as for soil radon concentration and exhalation assessment.

Participation in intercomparisons has shown good performance of the methods. Results will be presented at the International Conference on Radionuclide Metrology (ICRM2019).

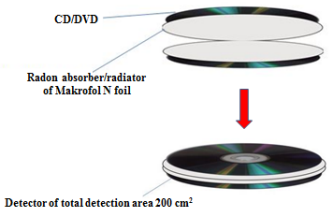

Fig. 3: The CD/DVD based detector of enhanced sensitivity and large total detection area

Radon mapping exercise

In the framework of the MetroRADON task "Harmonisation of radon priority areas across borders", different mapping methods of various countries are evaluated and tested for their comparability and usability for other countries. Therefore, two real-world indoor data sets together with geological and other geogenic supporting information from a region in Austria and Spain were supplied to the participants. This exercise was carried out by five institutions from all over Europe working on radon mapping in their respective countries. All participants analysed the data and applied their mapping method and definition of delineation of radon areas in their countries to the two test data sets. The task turned out challenging but results are consistent. An example is shown in Fig. 4. First results were presented at the GARRM workshop in September 2018.

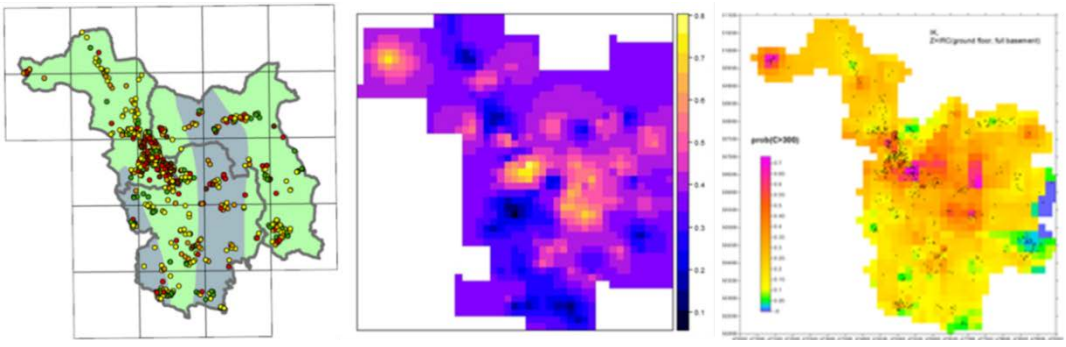

Fig. 4: Mapping exercise: Left – raw indoor radon data; centre and right – 2 examples of maps of the area

MetroRADON – upcoming events

Relevant upcoming conferences in the scope of MetroRADON in 2019 are: EURADOS winter school, Lodz; Radon in the Environment 2019, Krakow; European Geophysical Union (EGU2019), Vienna; International Conference on Radiation in Various Fields (RAD2019), Herceg-Novi; 5th International Conference on Environmental Radioactivity (ENVIRA2019), Prague; 9th International Conference against Radon at Home and at Work, Prague; 22nd International Conference on Radionuclide Metrology (ICRM2019), Salamanca.

More details can be found in the Upcoming Activities Section on the MetroRADON website.

MetroRADON – publications

New MetroRADON results were presented at several conferences in the second half of 2018, e.g. GeoENV Belfast, IAMG Olomouc and GARRM Prague.

The first open access peer-reviewed paper was published by MetroRADON partners:

Bossew, P., Radon Priority Areas – Definition, Estimation and Uncertainty, Nuclear Technology and Radiation Protection 33, 3 (2018) p. 286-292

Additional and more detailed information on the presented highlights and can be found in the latest Status Report.

All Presentations, posters, reports and papers can be found in the Documents Section on the MetroRADON website.

Further information and contact

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Fig. 5: The MetroRADON consortium at project meeting in Warsaw, November 2018