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CArbon-14 Source Term

CAST

Advisory Group Review of 2018 GAM and Final Symposium (D1.16)

Fraser King

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EURATOM

CAST – Project Overview

The CAST project (CArbon-14 Source Term) aims to develop understanding of the potential release mechanisms of carbon-14 from radioactive waste materials under conditions relevant to waste packaging and disposal into underground geological disposal facilities. The project focuses on the release of carbon-14 as dissolved and gaseous species from irradiated metals (steels, Zircaloys), irradiated graphite and from ion-exchange materials.

The CAST consortium brings together 33 partners with a range of skills and competencies in the management of radioactive wastes containing carbon-14, geological disposal research, safety case development and experimental work on gas generation. The consortium consists of national waste management organisations, research institutes, universities and commercial organisations.

The objectives of the CAST project are to gain new scientific understanding of the rate of release of carbon-14 from the corrosion of irradiated steels and Zircaloys and from the leaching of ion-exchange resins and irradiated graphites under geological disposal conditions, its speciation and how these relate to carbon-14 inventory and aqueous conditions. These results will be evaluated in the context of national safety assessments and disseminated to interested stakeholders. The new understanding should be of relevance to national safety assessment stakeholders and will also provide an opportunity for training for early career researchers.

For more information, please visit the CAST website at:
http://www.projectcast.eu

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Advisory Group Review of 2018 GAM and Final Symposium (D1.16)

Executive Summary

One of the tasks of the CAST Advisory Group is to review progress towards meeting the various project goals. This report describes a review of the minutes from the 2018 GAM and final symposium of the CAST project [CLARK AND NORRIS 2018]. In addition, a number of personal observations from the different presentations and posters from the meeting are provided.

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1 Introduction

One of the tasks of the CAST Advisory Group is to review progress towards meeting the various project goals. This report describes a review of the minutes from the 2018 GAM and final symposium of the CAST project [CLARK AND NORRIS 2018]. This was the fifth General Assembly Meeting of the CAST partners and took on a slightly different style from earlier meetings as it included presentations and posters from non-participants in related areas. In addition to a brief review of the minutes from the meeting (Section 2), some personal observations on the meeting itself and of the CAST project as a whole are provided (Section 3).

2 Review of 2018 GAM Minutes and Final Symposium

The minutes from the 5th CAST GAM and final symposium [CLARK AND NORRIS 2018] provide a detailed record of the proceedings, attendees, and the abstracts from the various presentations and posters. The inclusion of the abstracts in the minutes is particularly welcome as otherwise these would be lost from the project record.

The minutes themselves provide a brief summary of the overview presentations from the Work Package leaders and of the invited talks for each of the topic areas, with an emphasis on the aims, challenges, and highlights for each of the WP.

The meeting was well attended and, as always, there was a lot of open discussion and dialogue among the participants.

3 Personal observations from the CAST final symposium

The CAST final symposium was an opportunity to review the overall progress that had been made during the project. My personal observations and highlights from the meeting include:

- The obvious difficulties associated with obtaining and working with irradiated materials and the great efforts to which all participants went to overcome these difficulties.

- Quite apart from the difficulties associated with handling active materials, the low inventory and slow release rates of C-14 from leaching tests with various waste forms required a lot of effort to develop sampling and separation methods, as well as the measurement of C-14 itself.
- Corrosion studies in anoxic alkaline conditions are challenging because of the low corrosion rates of the order of nm/yr. Such low rates are typically not significant for most industrial applications and, hence, many conventional techniques for measuring corrosion rates are not sufficiently sensitive.
- Compounding these experimental difficulties is the fact that there appears to be a wide range of species produced from the different waste forms, including gaseous and dissolved fractions, and organic and inorganic species. Perhaps not surprisingly, the species produced depend on the type of waste form, with no predominant species that could be used in safety assessments to represent all sources of C-14.
- In some cases, the time required to obtain suitable samples and to develop experimental methods reduced the available exposure time for corrosion and leach tests. This was particularly unfortunate in the case of steels and zirconium alloys as these materials typically exhibit a decrease in corrosion rate over a period of several years.
- Progress has clearly been made in defining the C-14 inventory. For Zr alloys, activation calculations can provide an accurate estimate, whereas this approach is less successful for steels due to greater uncertainty in the precursor N content. For spent ion exchange resins, the variability associated with the type of resin, the location within the plant, the different types of plant, and the handling of the resins after they have been removed from service necessitate a dedicated sampling and analytical campaign to determine the inventory.
- Although not part of the CAST project, the presentation by Laurent Charlet highlighted the importance of reactions between released C-14 and corrosion products, cementitious materials, and carbonates for the transport and immobilisation of C-14 within the near and far fields. Microbial processes may also

result in a change of speciation of C-14 containing compounds that could affect transport through the natural barrier.

- When estimating C-14 release rates, it is important to take into account the form and environmental conditions associated with the actual waste. For example, C-14 is released from spent ion exchange resins by concentrated alkaline solutions (used to simulate concrete pore fluids), although no release (over laboratory timescales) is observed if the resins are embedded in a cementitious matrix.
- There were many examples of technology transfer between different partner organizations. This exchange of information was facilitated by several workshops that were arranged during the course of the project on topics such as analytical technique development, corrosion and leaching protocols, approaches to safety assessment, etc.
- Compared to how C-14 was handled in safety assessments before the CAST project, there has been significant improvement in terms of defining the inventory, understanding the speciation of released C-14, factors affecting the rate of release, instant release fractions, etc.
- The results of the CAST project confirm that the existing treatment of C-14 in safety assessments has been highly conservative, in terms of both the releasable inventory and the rate of release. It is to be hoped that organizations will now relax these conservatisms and develop more realistic C-14 source terms.
- Dissemination of information (WP7) from the project was always a central objective of CAST, but perhaps this WP has received less attention than other WPs at this and earlier GAMs. A wide range of engagement activities were planned and carried out during the project, including: the CAST website, training courses, workshops, newsletters, GAMs (much of which were open to the public), and project reports.
- It was never intended that the CAST project would be the final study on this topic and, indeed, a number of issues remain unresolved. A number of the experiments started during the project will continue and the final WP summaries provide an excellent starting point for future studies. In addition, as the prior CARBOWASTE project did for i-graphite, it is to be hoped that the CAST project laid the foundation

for improved understanding of C-14 speciation and release and additional mechanistic investigations in the future.

References

CLARK, A. AND S. NORRIS. 2018. General assembly meeting and minutes (D1.15). CAST (Carbon-14 Source Term) Report, issued 16/05/2018.