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Gammatec

A new experimental irradiation tool at Marcoule

V. Labeled



Gammatec: A new experimental irradiation tool at Marcoule



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- **September 2011:**
Beginning of construction of two ^{60}Co irradiators at Marcoule
 - An industrial irradiator
 - An experimental R&D unit including an irradiator and an adjacent analysis laboratory
- **A joint project between ISOTRON France (builder and operator) and CEA (“preferred” partner)**
- **Availability of irradiators: September 2012**



Why an experimental irradiation cell?



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- **Context : long-term storage of radioactive waste under gamma radiolysis**
 - ✓ Radiolysis of the waste containment matrix (glass, bitumen, etc.)
 - ✓ Radiolysis of the waste itself, especially if organic (technological waste)
- **Radiolysis: a major factor of waste aggression in a disposal repository**
 - ✓ Determine the behavior of the waste encapsulation matrix
 - ✓ Determine the nature of the waste degradation products
 - Hazardous or aggressive radiolysis gases
 - Complexants capable of leaching radionuclides present in waste packages
- **Need for an experimental tool to simulate aggression of waste materials**



A few existing gamma irradiation facilities



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**Irradiators of different designs,
not always well adapted for R&D requirements
(configuration, available volume, dose rate, etc.)**

➤ **CEA Marcoule: G1**

✓ MARCEL irradiation loop for solvents (1800 Gy·h⁻¹)

➤ **CEA Saclay**

✓ LABRA (several irradiation configurations)

➤ **Marseille: ISOTRON**

✓ Industrial irradiator (3000 to 6 000 Gy·h⁻¹)

➤ **Dagneux: IONISOS**

✓ Industrial irradiator (a few tens to a few hundred Gy·h⁻¹)

➤ **CEA Cadarache**

✓ DSV/IBEB: CIGAL irradiator (a few tens to a few hundred Gy·h⁻¹)





➤ **Experimental expertise**

- ✓ Design of experiments
- ✓ Test different configurations

➤ **Related equipment and expertise**

- ✓ Development of encapsulation formulations
- ✓ Study of waste/binder interactions
- ✓ Hydrogen diffusion in porous media
- ✓ Analytical equipment and methods
- ✓ Integration/modeling





➤ Analytic tests

- ✓ Identify the effects of irradiation
- ✓ Obtain basic data
(radiolytic yields, bubble nucleation mechanisms, etc.)
- ✓ Validate degradation mechanisms

➤ Integral tests on mockups


- ✓ Validate the description of coupled phenomena
(interaction with other constituents,
generated species removal kinetics, etc.)
- ✓ Test technological solutions



Advantages of future Gammatec experimental cell



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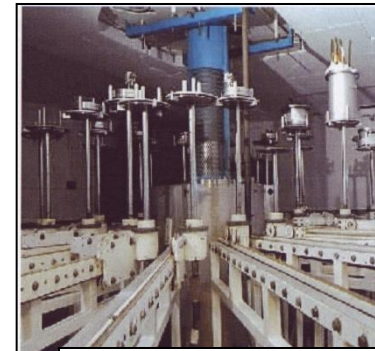
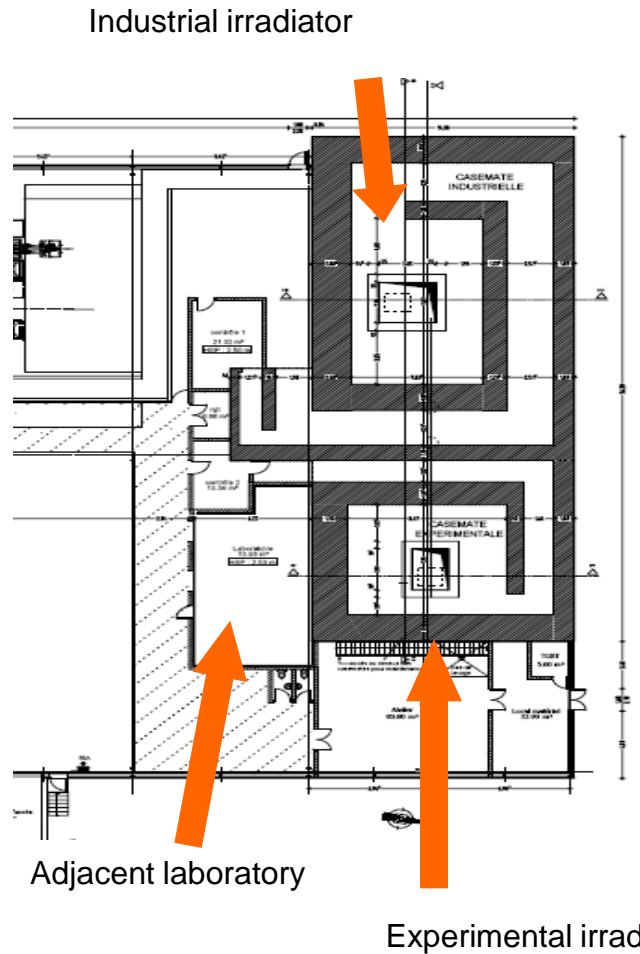
- An experimental unit comprising an irradiator and an adjacent analysis laboratory
- Similar to CIGAL design (rail emerging from central ^{60}Co source (activity 100 kCi) and turntables to homogenize the dose received by the sample )
- Variable range of controlled dose rates (a few tens to a few hundred $\text{Gy}\cdot\text{h}^{-1}$)(source distance and screens)
- Homogeneous irradiation of samples a ranging from a few mL to several liters
- Sample conveyor
- Irradiation cell temperature regulated to 20°C
- Sample irradiation from -20°C to 100°C in a specific device
- 8 gas sampling lines with online analysis
- 5 liquid sampling lines



Advantages of future Gammatec experimental cell



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CIGAL irradiator
at CEA Cadarache



Objectives and future programs



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- **Answer effectively to the R&D requirements of nuclear industrial firms (AREVA and EDF)**
- **Actively participate in the CEA radiolysis network on various issues (not limited to waste problems)**
 - ✓ Radiolysis in liquid media
 - ✓ Radiolysis in heterogeneous media
 - ✓ Theory and modeling
 - ✓ Radiolysis for biology
 - ✓ Radiolysis of organic materials
 - ✓ Interface with material irradiation
- **Develop joint programs in this area**
 - ✓ Internal: (DEN/DPC, DEN/DEC, DSM/IRAMIS, DEN/DRCP...)
 - ✓ External ...
- **Maintain expertise in experimental tests (specifications, sample configurations) and in understanding the phenomena involved (modeling)**
- **Develop new expertise**



Contacts



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