TREATMENT OF CONCRETE BARS FROM THE DISMANTLING OF HOT CELLS

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Abstract. The Central Decontamination Operations Department (HDB) of the Karlsruhe Research Center operates facilities for the disposal of radioactive waste. In general, their objective is to decontaminate radioactive residues for unrestricted release in order to minimize the volume of waste products suitable for repository storage.

In the case of about 120 concrete bars from the dismantling of hot cells, we reduce the volume of radioactive waste by sawing off the most contaminated parts of the bar. If there are no insertions such as cables or ventilation systems, the rest of the bar is sandblasted and its activity manually measured to ensure compliance with the release criteria. Otherwise, the bar is minced into small pieces by a power shovel. Afterwards, the rubble is filled into drums and its activity is measured by the clearance measurement facility.

If the rubble and the sandblasted bars do not exceed the activity limit specified by the release criteria, the material is disposed of without further regulations for unrestricted use. Those parts of the bars which can not be released must be stored in special containers suitable for the KONRAD final disposal.

Using this method, about 70 % of the total mass can be released.

DECONTAMINATION FACILITY

At the Karlsruhe Research Center, all solid, unburnable, and low-radioactive waste with a surface dose rate of up to a maximum of 10 mSv/h are transferred to the decontamination facility. Depending on their further processing, the delivered waste is sorted and transferred to various workplaces.

Surface decontamination of dismantled plant components for a later release of the material can be accomplished by mechanical or chemical methods. Waste with a smearable contamination of 0.5 Bq/cm² and 5 Bq/cm² in terms of alpha and beta activity, respectively, are processed directly at the workplaces in the hall or in the dismantling caisson. For this, cutting (rope saw, band saw for parts with an edge length of up to 1.6 m) and hydraulic processes are available. The caissons and the tent are operated below atmospheric pressure. The personnel working in the caissons wears gas-tight protective suits. In the decontamination caisson and the alpha caisson, decontamination is accomplished in a wet-chemical manner or with pressurized water and dismantling by thermal, cutting, or manual processes.

Depending on the task to be performed, the processing tent may be equipped with various machines or devices. This workplace is mainly designed for processing large components.

An independent blasting caisson is available for decontamination by surface removal. The blasting material is steel grid. Conditioning of rubble or concrete structures to waste products takes place in the rubble refilling facility. Besides refilling and concreting, various dismantling activities may be performed at this workplace.

Moreover, sludges and chemical effluents may be dried or solidified in the a caisson. A drying chamber is available for drying wet waste.

Waste is accepted in all common packaging forms. The hall is equipped with 2 cranes of up to 250 kN capacity. Heavy components and 20' containers may be brought in via rail systems. The heaviest component accepted for processing and decontamination so far had a weight of 156 Mg.

Workplace	**Crane design**	**Type of container, part size**	**Processing options**
Decontamination caisson (GP 02)	10 kN (bridge crane) 250 kN (bridge crane)	Boxes, 6'- 10' and 20' containers, R200/400/280 drums L=9 m	Bringing in or removal via lock, sorting, decontamination, drum handling, dismantling
Alpha caisson (GP 04)	5 kN (slewing pillar crane) 50 kN (rail crane trolley) 2 * 16 kN (bridge crane)	Boxes, 6'-10' and 20' containers, R200/400/280 drums L=5 m	Bringing in or removal via lock, sorting, decontamination, drum handling, dismantling
Hall (GP 05)	250 kN (bridge crane)	Boxes, 6'-10' and 20' containers, R200/400/280 drums L=11 m	Bringing in or removal via lock, sorting, decontamination, drum handling, dismantling, scrap sorting
Steel grid blasting facility (GP 12)	250 kN (bridge crane)	Boxes, 6'-10' and 20' containers, R200/400 drums (max. 3m*1.5m *1.5m)	Decontamination by steel grid blasting
Saw for large components (GP 14)	250 kN (bridge crane)	Boxes, 6'-10' and 20' containers, R200/400/280 drums (max. diameter 1.3 m)	Variety of sawing and cutting work
Dismantling caisson	250 kN (bridge crane)	Boxes, 6'-10' and 20' containers, R200/400/280 drums (max. 5 m*1.5 m* 1.5 m)	Dismantling, cutting, and burning taking into account conventional work safety regulations
Drying chamber (GP 21)	30 kN (bridge crane)	Max. 2*400 l drums or 2*280 l drums	Bringing in or removal via lock, drum handling, drying of compacts
Rubble filling (GP 15)	250 kN (bridge crane) 30 kN (rail crane trolley) 2 * 10 kN (slewing pillar crane)	Type IV containers, R200/400/280 drums L=4 m	Refilling of rubble drums, crushing of concrete parts, filling of containers, product qualification, control

Maximum capacity: 600 Mg/year
Material flows: 10% rad. waste, 30% scrap for melting, 60% material for unrestricted reuse
Techniques applied: Decontamination, crushing, sorting, repacking, solidification
Major working tools: 2 processing caissons, steel grid blasting system, saw for cutting large components, refilling and solidification systems

RELEASE MEASUREMENT FACILITY

Release of residues, e.g. removed plant components or buildings or building sections which have been decontaminated first, represents another important step in the treatment of radioactive waste. If the results obtained by release measurements are found to be below the limit values specified by the authorities, the waste materials are released from the scope of the regulations under the Atomic Energy Act.

For this, various procedures and measurement methods are applied at HDB. They comply with the requirements made by the authorities and have been proved to be suitable in practice in terms of both feasibility and performance.

In general, the following measurement methods are applied for release:

- Direct measurement by portable surface activity monitors together with sampling and analysis of the samples at the HDB release measurement laboratory.

- Direct measurement of surface activity.

- This type of release measurement is used to measure the waste surface by means of a contamination monitor. By a dynamic measurement, the activity maximum of a surface (partial surface) is determined and subsequently, the surface activity value is measured by stationary measurement. This measurement value is assumed to be representative of this partial surface. In case the nuclide composition for the residues to be subjected to release measurement contains nuclides which cannot be measured for technical reasons, these nuclides are considered by using the respective extrapolation factors.

- By parallel sampling and analysis of the material samples, information is obtained on the ratio of the key nuclides as well as on the activity that has possibly penetrated into the material.

- Measurement of larger volumes of identical material at the release measurement facility in combination with sampling and sample analysis at the release measurement laboratory of HDB.

The release measurement facility is based on the principle of total gamma measurement. Gamma quanta with energies of >200 keV are measured. The facility is calibrated using the key nuclide (mostly Co-60 or Cs-137) which is typical of the waste being subjected to release measurement. The measured activity is thus considered to be key nuclide-equivalent. The activity fraction of the remaining nuclides is taken into consideration by extrapolation factors. Calibration usually takes place using dummies that are identical to the material being measured. Standard calibrations are available for pipeline, sheet-metal, cable, insulator, and rubble materials. The material to be measured is brought into the facility in grid boxes (80 x 80 x 120 cm) or 200 l drums.

TREATMENT OF THE CONCRETE BARS

Before the arrival of the concrete bars, different samples are sent to HDB for analysis purposes. Depending on the results, the concrete bars are classified into three different groups:

- Steel grid blasting followed by direct measurement;
- Sawing off the most contaminated parts; and
- Mincing the bars into small pieces with a power shovel

Before the concrete bars are delivered to HDB, they are wrapped in foil and loaded in 20' containers. After opening the containers and unloading the bars, the contamination and the dose rate of the bars is measured to reconfirm the treatment.

Concrete bars without enclosures such as cables, ventilations systems, etc., and a surface contamination less than 0.5 Bq/cm² (alpha) and 5 Bq/cm² (beta) are steel grid blasted without any further pre-treatment. The success of the blasting is ensured by taking drilling samples and by measuring the complete surface contamination directly. If the release criteria of the HDB licensing are not exceeded, the bars can be released and disposed of as non-radioactive waste. Figure 1 shows concrete bars, which have already been released under the atomic act.

Fig. 1: Concrete bars after steel grid blasting and release measurements

If the concrete bars have any enclosures or the surface contamination is too high for steel grid blasting, the bar has to be pre-treated. If the enclosures are located within a small volume, the relevant part of the concrete bar is sawed off with a rope saw (see Figure 2). The parts whose contamination is too high are also sawed off before steel grid blasting is possible. The removed parts are inserted into special containers suitable for final disposal later on. After the sawing, the remainder of the concrete bar is also steel grid blasted and free release measurements are done.

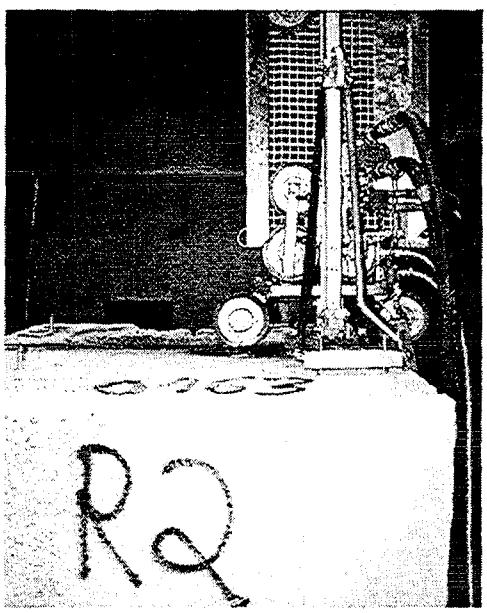


Fig. 2: Sawing off parts of a concrete bar by a rope saw

Concrete bars with many enclosures cannot be divided by rope sawing. To divide the concrete and the enclosures the bars are minced completely into small pieces by a power shovel (see figure 3). The concrete pieces with a diameter below 10 cm are filled into 200 l drums. To ensure that the release criteria are not exceeded the drums are measured automatically by the release measurement facility. If the release under the atomic act is possible, the 200 l drums are emptied and the concrete is disposed of as non-radioactive waste. The concrete, which exceeds the release criteria, is also filled into the same containers as the sawed-off parts. The concrete pieces are used to reduce empty space in the containers and to optimize the filling.

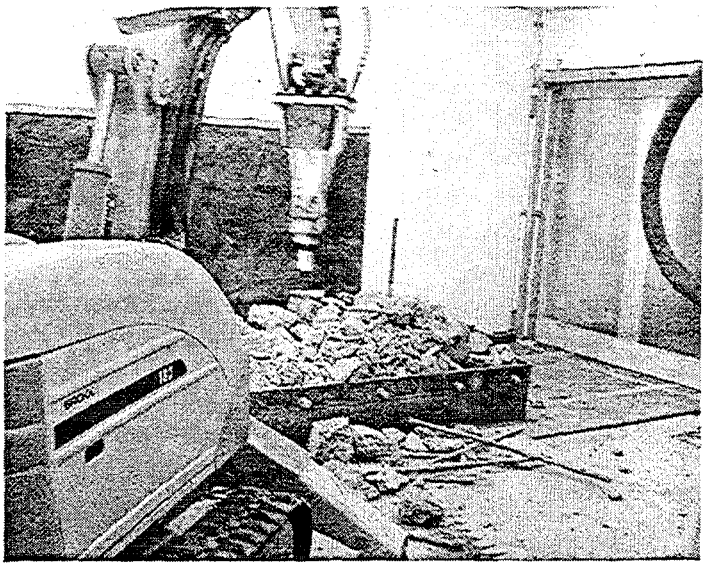
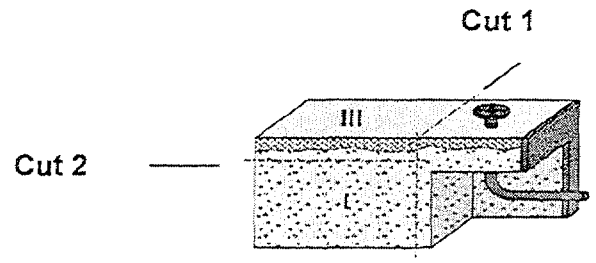


Fig. 3: Mincing the concrete bars with a power shovel

Besides the concrete, the bars consist of cables, metallic reinforcements, metallic liners and metallic enclosures. Since the cables cannot be measured for release, they are super-compacted to produce waste products for final disposal. The metallic reinforcements are measured by the release measurement facility and are also disposed off as non-radioactive waste. The other metallic components are delivered to a melting facility, which allows the radioactive waste to be melted for decontamination purposes.

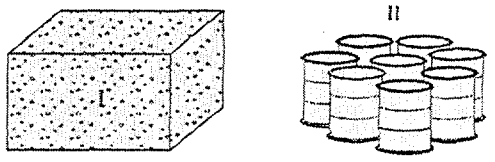
RESULTS OF THE TREATMENT

Step 1: Concrete bars during treatment:

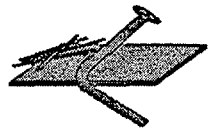


Step 2: Concrete bars after treatment:

Unrestricted release: about 68 %



Metallic structures for melting: about 10 %



Radioactive Waste: about 22 %

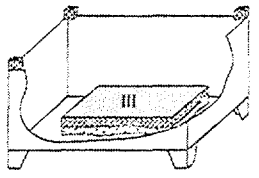


Fig. 4: Material flow during the treatment of the concrete bars

SUMMARY

The dismantling of hot cells results in a large amount of contaminated concrete bars. Since the main task is to minimize the volume of radioactive waste, a new concept was established. By sawing the concrete bars with no or only few enclosures into different parts, an effective decontamination by steel grid blasting can be done. This is not possible if the concrete bar consists of a large number of enclosures. In this case, only a mincing of the bar into small pieces provides a good result for the release measurement.

Due to the used method, only 22 % of the total volume becomes radioactive waste for final disposal. The additional 78 % are released for unrestricted reuse or are decontaminated by a melting process.

Besides the good release quota, another advantage of the treatment steps is that only well-known tools and methods are used. Due to this, the work can be done without longtime interruptions.