NEW TREATMENT FACILITY FOR OPTIMIZED CONDITIONING OF ACTIVATED CORE COMPONENTS

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ABSTRACT

In the course of decommissioning of one German BWR power station, a number of activated core components have to be prepared for interim storage in a shielded building at the NPP site. For optimum use of the storage capacity, a maximum volume reduction is to be achieved.

The components to be treated are 774 water channels and 130 control elements. The resulting material has to be packaged in special stainless steel drums which initially will be positioned in the fuel pool awaiting subsequent treatment. To package the material in the drums, the core components have to be cut by an underwater shear, and in order to achieve a maximum loading of the drum, after cutting the material is compacted by an underwater in-drum compactor. The integrated facility basically consists of the underwater shear and the in-drum compactor has been specially designed and built for this task. The paper will describe that equipment and the work to be performed.

Cutting/Compaction of BWR water channels and control elements

The normally achievable density of cut pieces of water channels and control elements loaded into drums of 150 to 200 liter size is around 12 % of the theoretical density or around 0.8 g/cm³ for water channel pieces and 1.0 g/cm³ for control elements. For improvement of the loading density, and subsequently reducing the storage capacity required, the material is compacted in its drum by a drum compactor, increasing the density to more than 20 % of theoretical or about 1.3 g/cm³ for the water channel material or 1.4 g/cm³ of the control element material can be achieved.

For accommodation of the cut parts two different types of stainless steel drums are being used:

- a drum with around 240 liter loading capacity for the water channel material and drive adapter parts of the control elements, and
- a drum with around 150 liter loading capacity for the material from the main parts of the control elements.

The core components are cut directly into these stainless steel drums in subsequent cutting steps. As the drive adapter parts of the control elements are of a more massive structure than their main parts, they would deteriorate the compaction result if simultaneously loaded into a drum with material from the main parts. Therefore the cut drive adapter pieces are collected in separate drums.

The cutting operation of the control elements are illustrated in Fig. 1. The sketch outlines the main functions of the cutting device, which basically consists of

- a fixing ram,
- a shear block, and
- two cutting length adjustment devices.

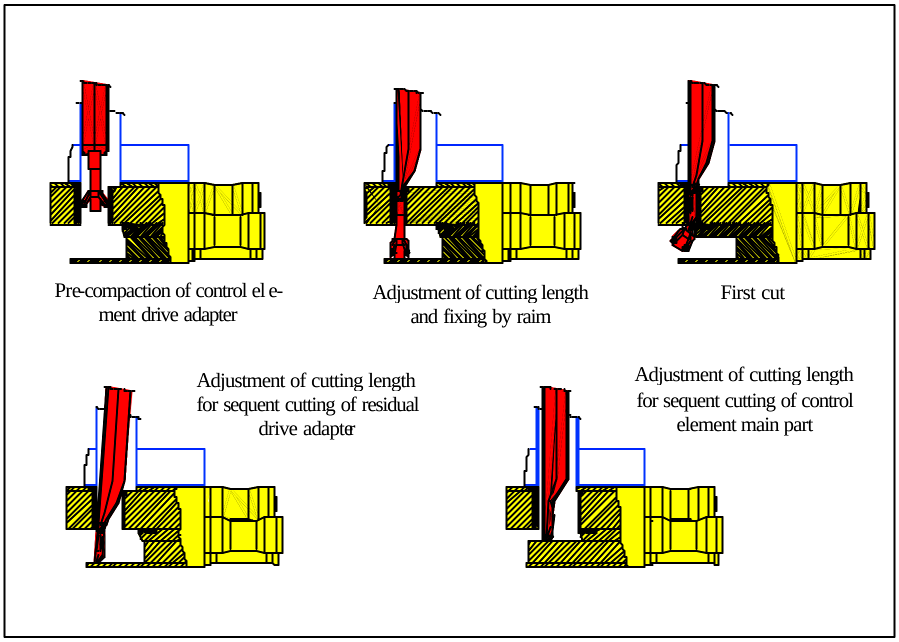

Fig. 1: Cutting of Control Elements

Initially the drive adapter parts are radially pre-compacted by the fixing ram. Then the cutting length of the first cut on that part is adjusted and the cut performed. Similarly by a second cut the adapter part is completely removed from the main part for collection in a separate drum. After removal of the drive adapter part, the main part is subsequently cut numerous times and the pieces are collected in a separate drum for subsequent compaction.

Cutting of the water channels is undertaken like cutting of the main part of the control elements and the material is collected in a drum for subsequent compaction.
The compaction scheme is outlined in Figure 2.

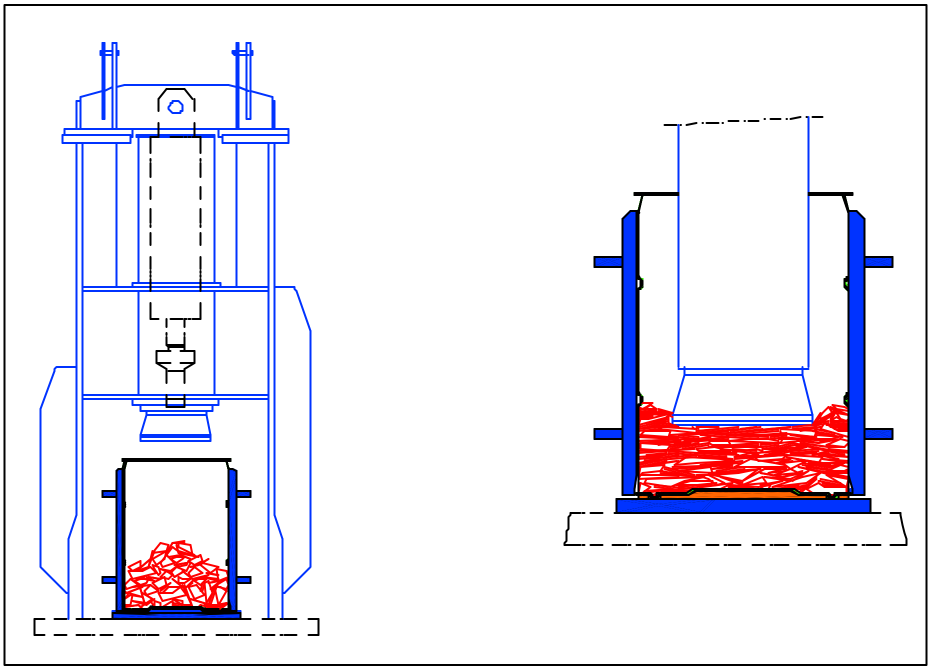

Fig. 2: Compaction scheme

The Underwater Cutting/Compactor

From what was described above , the equipment has to incorporate the following features:

- two drum-loading positions, of which one is for material that will not be compacted, and one for subsequent compaction,
- a cutter with a fixing ram, cutting length adjustment devices, material inlet and outlet, and a shear,
- the compaction device.

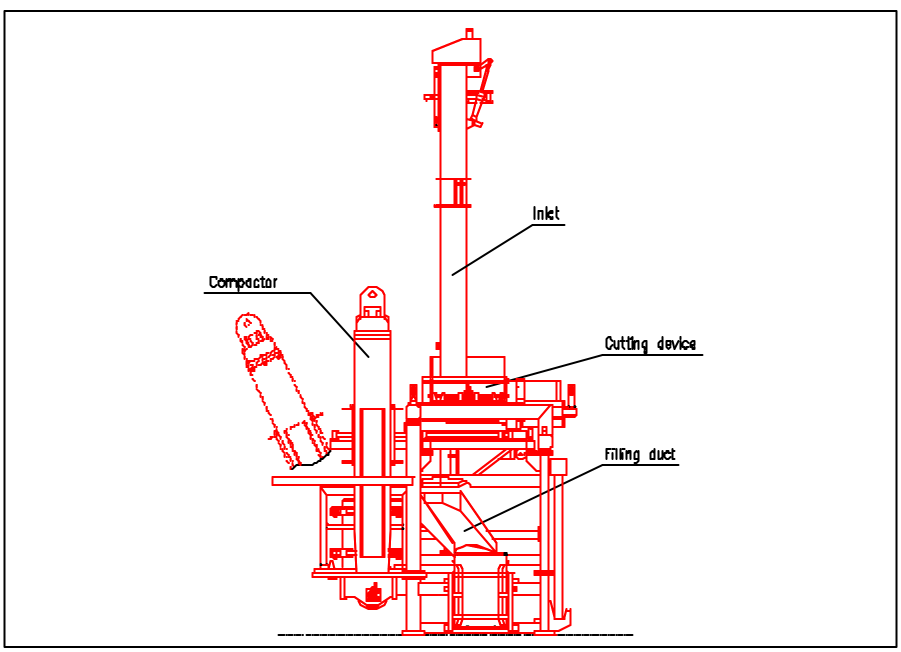

Fig. 3: Underwater Cutting and Compaction Equipment for Activated Core Components

The assembly of these features is shown in Fig. 3. The equipment is built up as single modules mounted on a basic frame. All modules are assembled under water by vertical movements only, and guide ducts will assure their proper positioning. Of the two drum loading positions, one is located within the basic frame, and the other is located at the compactor position. The compactor itself is composed of a declinable hydraulic cylinder with piston and compacting ram. During compaction the drums are protected against destruction by a surrounding metal jacket. The cut material is fed to the drum loading stations via a sliding funnel. The equipment is surrounded by a metal housing, and debris and possibly developing dust is collected in a filter through a defined water flow which keeps all the working areas clear. Video cameras provide a view of the working areas inside the equipment.

The equipment is actuated by a hydraulic system, operating with demineralized water.

The total weight of the equipment is 20 tons, the force of the cutting blades is 100 tons, and the force of the compactor is 50 tons. The operating pressure of the hydraulic system is 250 bars.

Fig. 4 shows a top view of the system

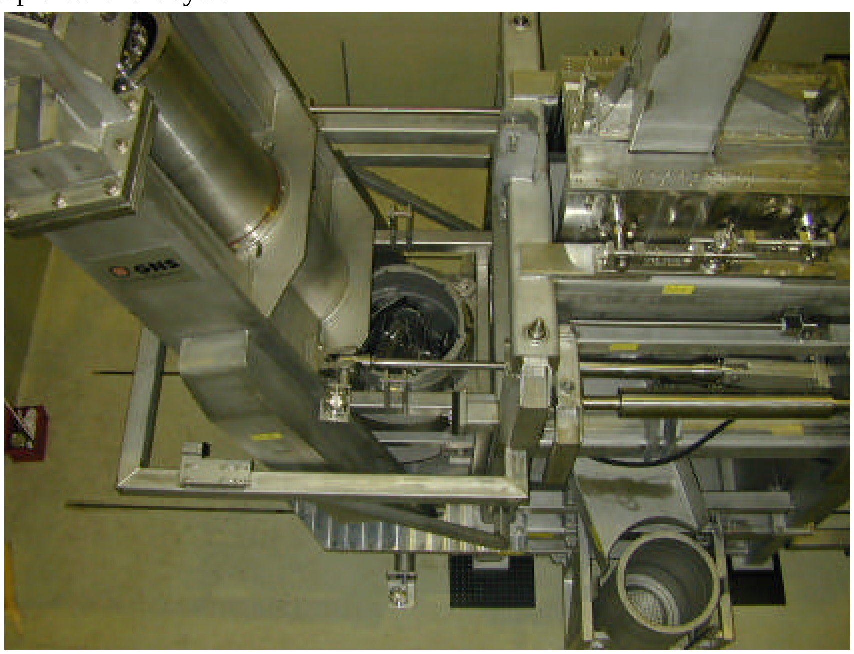

Fig. 4: Top View on Underwater Cutter/Compactor

Results

At the end of the job the maximum number of drums filled with cut and compacted material from 774 water channels and 130 control elements, equivalent to 36,000 kg expected:

- 67 drums with 240 liter loading capacity, and
- 30 drums with 150 liter loading capacity.

In total, this corresponds to a storage volume of 30 m³. Without compaction, the storage volume would have been around 50 m³, volume saved thus is 20 m³. In terms of repository costs as presently anticipated in Germany, this represents a saving of about 1 million $