



„MOSAIK®“ 20 Years of Experience with a Cask System for Transportation, Conditioning and Storage of Radioactive Waste

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In Europe shielding casks for transportation and storage of radioactive waste with higher specific activity are in use. These casks developed by GNS and fabricated from ductile cast iron are called MOSAIK® cask. At the moment 4 main types with some subtypes, named MOSAIK® I, II, III and 80 T, are in use.

The MOSAIK® casks are licensed for the German interim storages and the planned final repository MOSAIK® II and MOSAIK® 80 T are licensed as a type B(U) cask also.

Till now more than 4100 MOSAIK® cask have been built and loaded with radioactive MAW material.

INTRODUCTION

At the beginning of the 1980's, GNS started the development of a cask for transport and storage of activated core components with high dose rates. The cask was named MOSAIK® for „**m**obiles **S**ystem für **a**ktivier**e**te **K**ern**b**auteile“. This cask (later called MOSAIK® I) is relatively small and manufactured from ductile cast iron just as its big brother CASTOR. MOSAIK® I casks were built with a wall thickness of 150 mm and an additional lead shielding between 60 and 120 mm. Its unloaded weight varies between 3,350 and 5,000 kg.

The MOSAIK® I casks was only used to accommodate activated core components cut under water. Due to the relatively low effective volume of 186 l to 49 l, the cask was only used to load parts with a relatively high specific activity.

At the beginning of the 80's concrete shielding casks with 1,06 m diameter and a high of 1,50 m were in use. To use the available handling equipment for these casks. GNS developed a second MOSAIK® with the same outer dimensions and a wall thickness of 16 cm.

This MOSAIK® II-15 became a real multi-purpose cask and is used today for practically all types of wastes.

A third cask, the MOSAIK® III, was developed to load dried evaporator concentrate with a special customer-owned facility. Because this MOSAIK® is a very specific custom design, only statistical information will be given in this paper.

In 1992 GNS started with the development of the last MOSAIK® until now, the MOSAIK® 80 T. This cask is designed to transport complete activated core components from reactors to external conditioning facilities or for storage of these materials before conditioning.

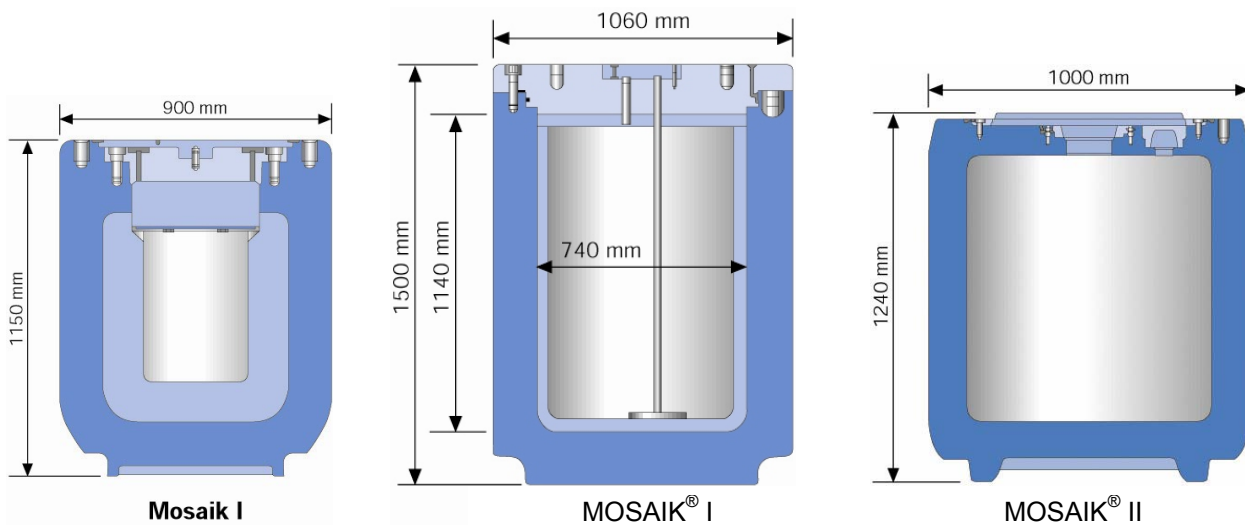


Fig. 1. MOSAIK® Casks

MOSAIK® I cask

The MOSAIK® I cask was developed to load activated core components cut under water into the cask. The cask body was produced from ductile cast iron (GGG 40) and had a wall thickness of 150 mm. The cask was closed with a shielding lid of the same dimension and an additional protecting lid to save the shielding during handling and storage. To increase the shielding, all MOSAIK® I casks were equipped with an inner lead liner between 60 and 120 mm.

To load the MOSAIK® I under water in a first step, the cask body was placed inside the pool hanging on steel cables. Then the cask was loaded with the activated materials by setting a bucket prepared before into the cask or loading the cut pieces manually with tongs into the empty cask. Next the shielding lid was placed on the position and the MOSAIK® was taken out of the water. After bolting the lid, the inner space was dewatered and dried through drying openings in the lid. When the protection plate was added and the decontamination of the surface was done, the cask

was ready to storage. Till mid of the 1980s, in total 68 MOSAIK® I casks were loaded with this procedure. 36 of them were loaded with first core absorber elements from pressure water reactors and 32 with other material such as neutron sources and measurement equipment. The Co-60 activity in these casks is out the average 1.0×10^{13} Bq or 283 Ci.

MOSAIK® II cask

The MOSAIK® II cask was developed in parallel to the MOSAIK® I cask. The first idea was a shielding cask with the outer diameter of 1060 mm, like the often used concrete shieldings to load in 200-l drums. This cask had the same lid construction as the MOSAIK® I but is only 1365 mm high.

The next step in development led to the MOSAIK® II which is comparable in its outer dimensions to the often used concrete shielding cask. This cask became a real multi-purpose cask and is used today for all types of waste which need a heavy shielding. The cask body of the MOSAIK® II cask with a wall thickness of 160 mm is used for all purposes. For the different types of waste or the different methods of waste conditioning, the MOSAIK® II is equipped with variable cask lids and installations. To provide the necessary shielding, additional lead liners can be built in up to 140 mm thickness.

In Fig. 2 different customer-specific MOSAIK® II versions are shown. The M II-15 Pu is a MOSAIK® cask to load with activated core components. For this, the lid has only small openings for dewatering and drying the cask interior and there is a heavy lead shielding installed.

The M II-15 is equipped with a filter lance to dewater the ion exchange resins which are transported with a water flux into the cask. This cask is fitted with a relatively thin lead shielding (20-40 mm). The M II-15 KKI 1 and the M II-15 ISAR are MOSAIK® for conditioning of evaporator concentrates and mixtures of resins and concentrates. These cask types are used with the vacuum-drying process (FAVORIT). For these types of wastes, normally no additional shielding is necessary.

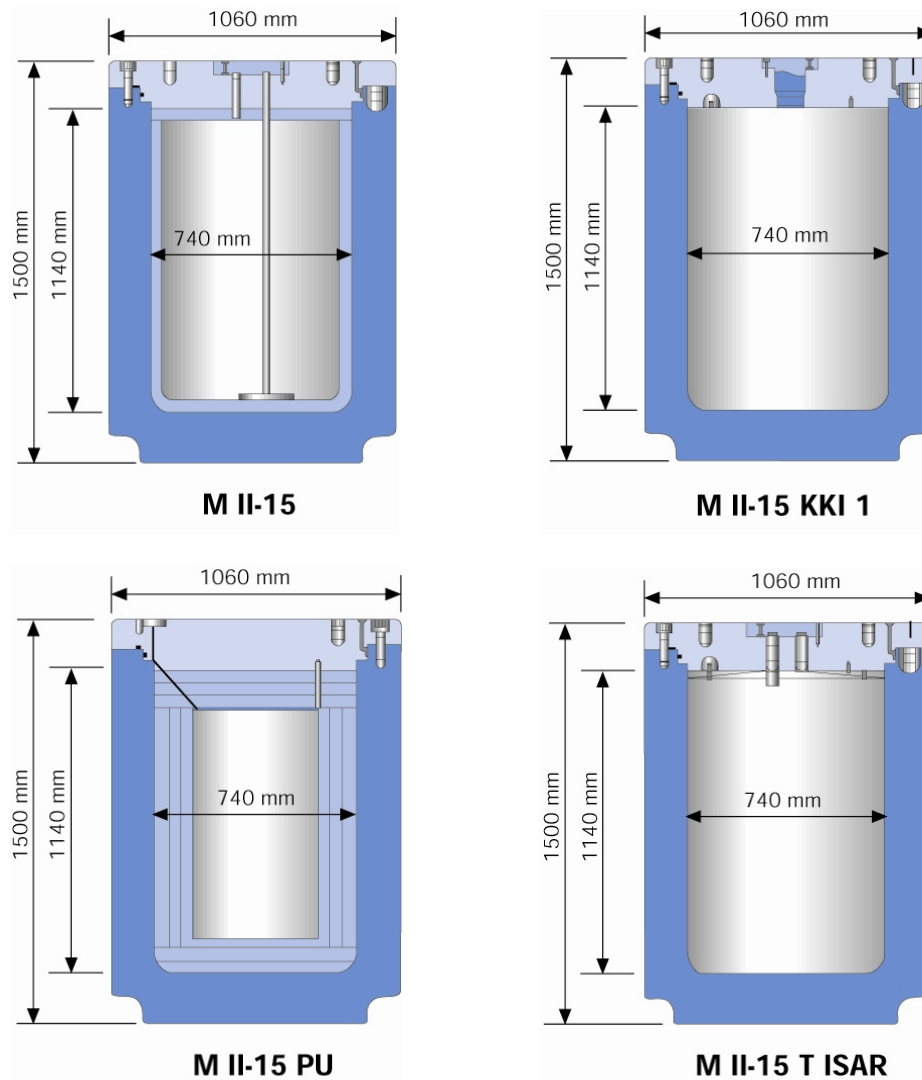


Fig. 2. Customer-specific MOSAIK® II versions

During the last 20 years some special purposes have been developed and licensed for the MOSAIK® II, for example a MOSAIK® II to transport medical Co-60 or Cs-137 sources and fissile materials.

MOSAIK® II casks have a Type B(U) license for many different wastes and are licensed for interim storage and the planned final repository. For Type B(U) transports the MOSAIK® II casks are equipped with shock absorbers. Leak-tightness tests are performed before the transports.



Fig. 3. MOSAIK® II casks with shock absorbers

MOSAIK® 80 T

The MOSAIK® 80 T was developed at the beginning of the 90's as a transport and storage cask to bring activated core components from boiling or pressurised water reactors to external conditioning facilities.

The MOSAIK® 80 T/66 is a cask with a total weight of 80 t (M 80T) and is mainly used to store and transport 66 water channels from boiling water reactors. In total 792 channels have been transported to the MAW scrapping plant at the research centre Karlsruhe and are conditioned there successfully. Beginning this year the first 80 T was loaded with regulator elements from boiling water reactors. This cask is used for interim storage before conditioning later this year.

GNS has 6 MOSAIK® 80 T casks available with 2 different baskets for boiling and pressure reactor vessel core components.



Fig. 4. MOSAIK® 80 T with transport equipment

Experience

During the last 20 years, over four thousands of different MOSAIK® casks have been used for conditioning of different waste types. Tab.1 shows the different casks and waste which were treated.

Table I. Conditioned waste at MOSAIK® casks till 2003

	Loaded with				Total
	Activated Metals	Ion exchange Resins	Evaporator concentrates	Mixed MAW	
MOSAIK I	68	-	-	-	68
MOSAIK II	473	944	1713	238	3368
MOSAIK III	-	-	780	-	780
				Sum	4216

All these casks are stored in interim storages at the power plants or in external facilities. During the long storage period of more than 20 years, on many casks with different contents have been tested to check the reaction of the waste product and the cask safety. The results of these tests lead to some changes in the waste treatment, for example, total drying of the activated core components to stop pressure build-up.

CONCLUSION

With the casks of the MOSAIK[®]-family, GNS has a system available which allows an easy treatment and conditioning of all wastes with higher specific activity.

MOSAIK[®] casks are loaded with activated core components under water or in hot cells. They are used for the conditioning of ion exchange resins and other filter material as well as for the indrum drying of evaporator concentrates and mixtures of these materials.

With the MOSAIK[®] 80 T large activated core components can be removed from the storage pool and transported to external conditioning facilities. MOSAIK[®] II and 80 T casks are licensed as Type B(U) casks. To optimise the shielding of MOSAIK[®], an inner lead liner can be installed if necessary. The MOSAIK[®] II cask with weights between 5800 kg and 9800 kg can be handled relatively easy with cranes or heavy forklifts.

All MOSAIK[®] casks have a smooth, easy decontaminable surface.

Type B(U) transport with MOSAIK[®] casks needs additional shock absorbers.

For new materials or sources, in many cases small technical adaptations are possible to obtain a supplementary licence.