

# **Manual**

## **Assembly and Operation of Hospital Waste Incinerator for Disaster Relief and Rural Hospitals (HWI-4)**

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**Technologie Transfer Marburg in die Dritte Welt e.V. (TTM)  
Marburg, Germany**

## Prefix

As long as disasters have made it necessary to deploy medical teams, ERUs or field hospitals, medical personnel has faced the problem of efficient and safe hospital waste disposal. Burying large amounts of waste is often limited by available space, and it may contaminate the soil and groundwater resources. There is also the constant danger of contaminated waste being dug up by playing children or roaming animals. Open burning is often difficult due to weather conditions, involves long burning times, and is dangerous due to the possible formation of noxious or irritating fumes.

A similar situation was discovered in rural hospitals of developing countries where the limited financial resources don't allow the use of sophisticated and costly modern incinerators. Locally fabricated simple solutions on the other side are often not able to meet the minimum requirements of a safe and environmentally friendly treatment of hazardous clinical waste.

In 1999, the German Red Cross Society had gathered sufficient evidence from delegates that safe hospital waste disposal under field conditions was a serious problem. Also small rural hospitals and clinic in developing countries face similar problems and search adequate solutions. An investigation of the market revealed that no incinerator system was available that combined a powerful burning process with the possibility of easy transport, easy assembly, and easy operation and maintenance

In collaboration with "Technologie Transfer Marburg in die Dritte Welt e.V. (TTM)" and Dr. Heino Vest, an experienced waste management expert, the German Red Cross Society initiated the development of a solution to the problem. The experts were to construct an incinerator with the following features:

- able to fit on a standard Euro-palette for easy air transport;
- constructed in a modular fashion to facilitate easy on-site movement and assembly with a minimum of equipment and technical skills;
- a capacity sufficient to deal with the average amount of clinical waste of field hospitals;
- able to generate sufficient heat to ensure a effective and complete burning and safe destruction of problem waste like sharps, plastic, amputates and body parts, and wet or moist matter;
- assure a complete combustion of the generated fumes to minimise the air pollution.

Several development steps - construction of a prototype in Germany, subsequent modification and a final field test in a Tanzanian hospital - led to an optimised (patented) design which became the basis of the serial production of the Hospital Waste Incinerator HWI-4 for Disaster Relief and Rural Hospitals in Developing Countries.

# 1 Operation Permit and Liabilities

The Hospital Waste Incinerator HWI-4 manufactured by RefraServ GmbH, Kloetze (subsequently called "**Manufacturer**") and supplied by Technologie Transfer Marburg in die Dritte Welt e.V. (TTM), Marburg, Germany (subsequently called "**Supplier**") is primarily designed and manufactured for the incineration of hospital waste **under emergency situation**. It was developed according to the needs and recommendations of the German Red Cross Society (DRK) and similar institutions active in disaster relief operations (subsequently called "**User**"). It shall serve as environmentally acceptable solution for the treatment and disposal of medical waste generated by field hospitals, emergency clinic, rescue teams, and under certain circumstances also by rural hospitals and clinics in developing countries.

HWI-4 is manufactured from high quality materials under German standards of production (see Technical Data Sheets in the Annex of the Manual). The Manufacturer guarantees the designed technical properties of the incinerator and has controlled the functioning of all parts, in particular the diesel burner. The **Manufacturer is not responsible** for damages resulting from transport and unpacking of parts, unless the User proves that they result from insufficient packaging material or inappropriate transport containers.

HWI-4 is a simple incinerator without a sophisticated off-gas cleaning system. The User should therefore have no unrealistic expectation regarding the achievable off-gas quality. The targeted **emission quality** (only little visible smoke) can only be achieved through **careful operation according to the recommendations of the manual**.

**Only hospital waste** like syringes and needles, one way scalpels and empty ampoules, infusion tubes and **open** bottles/bags, used plasters, bandages and one way gloves including their packaging are allowed to be incinerated by HWI-4. Tissues, bacteria cultures, organ parts and to a minor extent outdated drugs and pharmaceutical waste can also be charged to the furnace.

It is **not allowed** to incinerate materials or items for which HWI-4 is not designed for such as:

- |                       |   |
|-----------------------|---|
| Explosives:           | Ammunition, pressurised spray containers, <b>closed</b> empty bottles/containers, and in particular those with remains of burnable liquids (e.g. alcohol, fuels, solvents); |
| Chemicals:            | Acids, bases, dry chemicals <b>except</b> outdated drugs and cytotoxic medicine;  |
| Apparatuses:          | Electrical or electronic devices, batteries, and in particular mercury containing thermometers or manometers;   |
| Radioactive material: | Radioactive material of any kind.   |

HWI-4 must be **operated by authorised and trained personnel** only. The first assembly and the subsequent incineration processes have to be carried out strictly according to the instruction in the manual. The operator has to observe all safety regulations and precautions. Manufacturer and Supplier are not liable for any damage or injuries caused by improper assembly or unsafe operation on the side of the User.

The operation of an incinerator for hospital waste may need a special permission by the local authorities in the respective country. The User of HWI-4 is responsible to apply for the required permissions. **Manufacturer and Supplier are not liable** for failing to fulfil the local regulations or for any consequences resulting from an operation without local permission by the User.

## 2 Short Description of Incinerator

The HWI-4 (Picture 1) consist of a set of prefabricated parts which need to be assembled before use. Core elements are six heat insulating fire-resistant frames and covers which form the body of the incinerator supplemented by two incinerator door and a diesel burner. The chimney is 6 m high and mounted on the incinerator itself.

Picture 1:

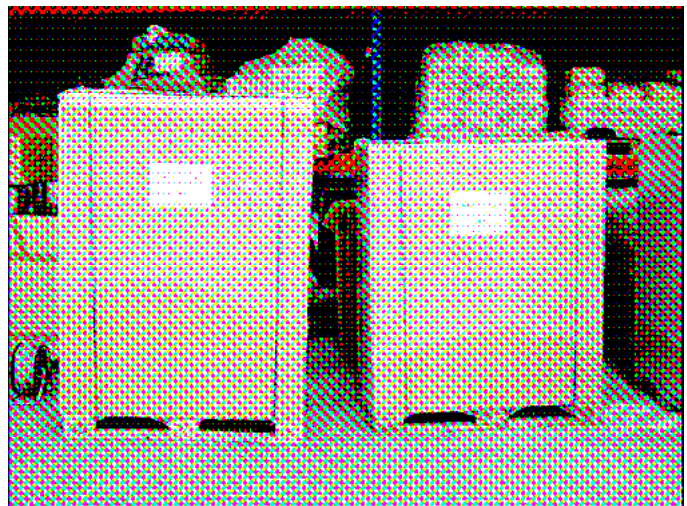
Incinerator HWI-4



The incinerator parts are packed on 2 Euro-pallets of the approximate size of 80x120x150 cm (Picture 2). The total weight of the shipments is approximately 1,200 kg. In order to make it possible to move the individual boxes/parts without major technical gear, the max. weight of an individual box/part is limited to 220 kg. Attached handles and included transport metal bars make it possible for 4-8 persons to move the boxes and incinerator parts (Picture 3, 4 and 5).

Picture 2:

Pallets with incinerator parts ready for transport





No.3



No.4

Picture 3-5:

How to carry the transport boxes



No.5

The incinerator is equipped with a diesel burner of 10-13 KW, consuming approximately 3 l of diesel per hour. Main function of the burner is to after burn the combustion fumes in the upper part of the incinerator. During the two hours incineration process of a standard charge of 25 kg, the temperature in the main combustion zone of the incinerator will reach about 1250 °C.

### 3 Content of transport boxes, packing lists

The whole shipment of the incinerator comprises of 2 pallets. Each pallet carries 3 incinerator frames and 1 box for spare parts. The content of each pallet is given as follows:

#### Contents of each pallet

<b>Pallet/ Box</b>	<b>No.</b>	<b>Type of equipment</b>	<b>Reference No.</b>
Pallet 1	1	Ceramic incinerator bottom (No.1)	FF-001
	1	Steel plate for ash chamber	ST-035
	1	Ceramic incinerator frame (No.2)	FF-002
	2	Cast iron grid	GS-3040
	1	Ceramic incinerator frame (No.3)	FF-003
	3	Ceramic partition wall	FF-430
	1	Lower ceramic incinerator door 500/700mm with steel frame (No.8)	FF-008
	1	Pre-assembled burner support frame	VS-70
	25m	Ceramic rope Ø 25mm	KR-001
	Box 1 cont.	1	Diesel burner (Ruhr Brenner)
4m		Electrical connection wire	B-004
2x2m		Fuel pipe	B-002
1		Gasket	B-006
1		Filter	B-007
6		Steel carrying handles	TR-001
1		Pair of welding gloves	Z-005
1		Safety goggles	Z-002
4		Pair of leather gloves	Z-001
1		P2 filter mask	Z-003
1		Spanner (SW7)	Z-007
1		Spanner (SW19)	Z-019
2		Spanner (SW24)	Z-024
8		Ceramic paper 500/ 45/ 3 mm	KP-002

<b>Box</b>	<b>No.</b>	<b>Type of equipment</b>	<b>Reference No.</b>
Pallet 2	1	Ceramic incinerator frame (No.4)	FF-004
	1	Ceramic incinerator frame (No.5)	FF-005
	1	20l fuel jerry can	Z-020
	5 kg	Superplast filler material	47-X3
	2 kg	Water glass cement	RT-1800
	1	Ceramic incinerator top (No.6)	FF-006
	1	Ceramic explosion cover (No.7)	FF-007
	1	Upper ceramic incinerator door 700/700mm with steel frame (No.9)	FF-009
	Box 2	6	Steel chimney segment 150/1000/0.6mm
1		Steel rose cover	RK-0101
1		Chimney top cover	RK-0102
25m		Steel suspension rope	RKZ-0110
14		Rope clamp	RKZ-0111
12		Rope eye	RKZ-0112
4		Spring 10cm	RKZ-0113
1		Ring fastener for suspension robes	RKZ-0114
1		Metal rope cutter	RKZ-0115

## 4 Assembly of Incinerator

### 4.1 Appropriate place to install the incinerator

The incinerator can be operated outside of a building, but it needs to be sheltered from rain. Therefore it is recommended to provide a roof shelter, preferably made of corrugated metal sheets. If only a tent or a thatched roof is available, it is important to **keep the chimney clear of the tent cloth or thatch**. During operation, the chimney reaches a temperature of up to 500°C, which is sufficient to ignite tent cloth or thatch.

A small separate building would be the best solution to house the incinerator. Some thought should be given to investigating the main wind direction. The incinerator should be placed out of the wind, allowing **the smoke to be carried away from dwelling areas**. Installing the incinerator inside a building has the added advantage of providing adequate intermediate storage for the incoming waste which then, more importantly, can be locked away to prevent unauthorised persons from getting into contact with the waste.

To operate the incinerator **electricity of 230 V** has to be provided. The incinerator may either be connected to the mains or a mobile generator may be used.

### 4.2 Instructions to assemble the incinerator

The following step by step instructions explain how to assemble the incinerator correctly. All major assembling steps are illustrated by photographs. Workers in charge of the assembly should wear the protective gloves included in the shipment.

#### 4.2.1 Assembly of the incinerator body

- Place bottom element (FF-001) at the preferred position where the incinerator shall operate! (Picture 6)
- Ensure that the sealing rope is still in place and put the four short conic metal centre pins (KR-001) in each corners whole of the bottom piece. *This has to be repeated for each incinerator segment.* (Picture 7)
- Insert the four metal bars (TR-001) (Picture 8) into the respective wholes at the side of the first incinerator frame (Picture 9), turn them by 180° and lift the part with four persons and place it carefully on the bottom element. (Picture 10 and 11) Additional wholes are provide in case it is necessary to handle the frame with more than 4 Persons (max. 8 persons).
- Insert the first segment of the ceramic partition wall (FF-430) (Picture 12)
- Place the cast iron grids (GS-3040) into the first incinerator frame (FF-002) on top of the bottom element (FF-001) (Picture 13)
- Place the third incinerator frame (FF-003) on the top of the second one applying the same procedure (Picture 14)

- Place the fourth incinerator frame (FF-004) on top of frame number three (Picture 15)
- Insert the second segment of the ceramic partition wall (FF-430) (Picture 16)
- Place the fifth incinerator frame (FF-005) on top of frame number four (Picture 17)
- Insert the third segment of the ceramic partition wall (FF-430) (Picture 18)
- Place the top cover element (FF-006) on the frame number five (Picture 19)



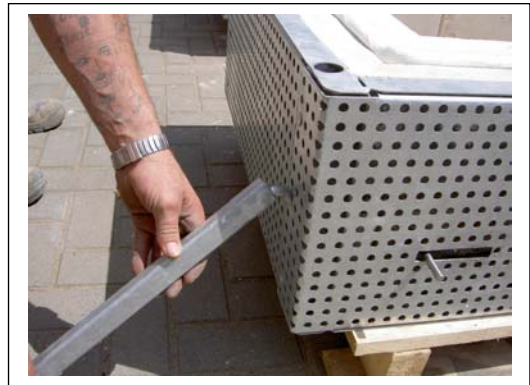
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No.7



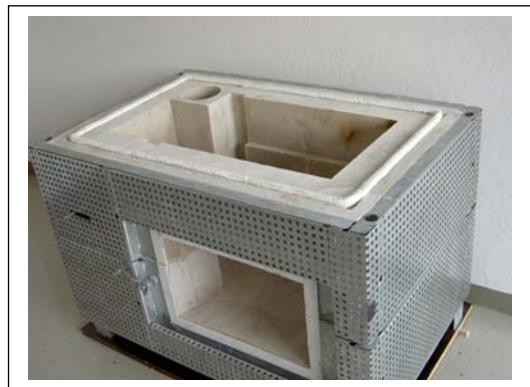
No.8



No.9



No.10



No.11



No.12



No.13



No.14



No.15



No.16



No. 17



No.18



No.19

#### 4.2.2 Assembly of the doors, burner and chimney

- Position the lower door (FF-008) with two persons in front of the lower door opening and insert the bolts into the prepared wholes of the metal frame (Picture 20). Tighten the two nuts at each bolt in such a manner that the door is levelled horizontally and fits exactly into the door opening (Picture 21 and 22)
- Repeat this with the upper door (FF-009) applying the same procedure (Picture 23)
- Fix Diesel burner on burner support frame (VS-70). *Do not forget to insert the gasket (B-006) between burner and burner plate attached to the burner support frame!* (Picture 24, 25)
- Insert the first steel chimney segment (RK-0100) into incinerator! (Picture 26)
- Place steel rose cover (PK-0101) over the first chimney segment (Picture 27)!
- Prepare one steel chimney segment with the chimney top cover (RK-0102) and the ring fastener for the suspension ropes (RKZ-0114) (Picture 28, 29)!
- Attach the 3 steel suspension robes using rope clamps (RKZ-0111), springs (RKZ-0113) and rope eyes (RKZ-0112) (Picture 30)!
- Mount the top and the 4 remaining chimney segments on the first one already attached to the incinerator!
- Fix the 3 suspension robes at suitable places (at the roof, by using earth anchor or fence posts) to secure the chimney's stability!



No. 20



No.21



No. 22



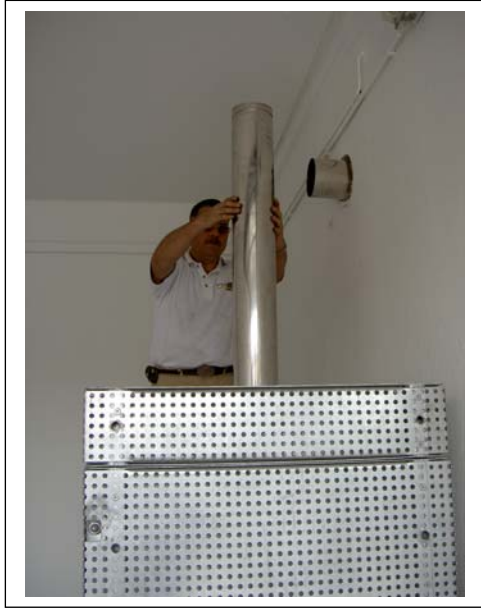
No. 23



No.24



No. 25



No. 26



No. 27



No.29



No. 28



No. 30

### 4.2.3 Electrical installation of burner, fuel supply of burner

After attaching the burner to the incinerator it needs a connection to the power and fuel supply.

To **connect the burner to the mains or to a generator** the electrical cable attached to the burner has to be fitted with a plug appropriate for the local system. *Please note that the burner is delivered without a mains plug.* Since every country has its own electrical plug and socket system, it does not make sense to supply the burner with a German type of plug.

When connecting the burner cable to the plug it is **important to make sure that the phase (Ph) is connected to the phase of the mains and the zero conductor (Mp) is connected to the MP of the mains.** *If the plug is designed symmetrically, a turning of the plug in the socket by 180° will cause the burner to fail.*

For the connection of the burner to the fuel supply insert the two fuel pipes attached to the burner into the fuel (diesel) container (Picture 31). The shipment includes a metal jerry which can be used as fuel container for the incinerator. Any other *metal container that is safe to be used with fuel* may also be used.

Note: it is important that **both ends of the fuel pipes are submerged in the fuel.**

Picture 31:  
Fuel supply



Picture 32: Completely installed incinerator



## 5 Operation of Incinerator

*The incinerator must be operated batch wise!*

To achieve the highest possible emission standard, the incinerator must be operated **batch wise**. Therefore, the total charge to be incinerated is filled into the incinerator before it is started, and **no additional waste must be fed into the furnace during incineration**. After one batch of waste has been burned, the furnace needs a cooling period of 4 hours before the next charge can be prepared.

### 5.1 Preparation of Waste Charge

*Prepare an appropriate waste mix!*

Hospital waste is not homogeneous. Besides a large amount of plastic and paper waste, non-combustible glass and metal components, bandages soaked with body fluid, tissue and organ parts have to be incinerated. While plastic and paper waste generate energy and heat during combustion, wet bandages and organ parts consume energy. In order to achieve good combustion properties an **appropriate waste mix** has to be secured.

A **good mix** of waste consists of:

50 to 60 % of plastic and paper waste,  
20 to 25 % of (wet) bandages,  
15 to 20 % of organ parts,  
5 to 10 % of sharps (scalpels, needles, glass ampoules).

If no organ parts have to be incinerated, the amount of wet bandages can go up to 40% of the total waste to be incinerated.

It should be avoided to burn items made of PVC, since it leads to an increased formation of polychlorinated hydrocarbons (dioxins) in the off-gas.

Empty bottles/containers **have to be opened** before charging to the furnace. While minor residues of the former content can remain in the containers, it should be avoided to charge half-full or full containers. *Containers or bottles with burnable liquids like alcohol, solvent and fuel must not be incinerated!*

*Never incinerate the following items!*

Explosives:	Ammunition, pressurised spray containers, closed empty bottles/containers, and in particular those with remains of burnable liquids (e.g. alcohol, fuels, solvents);
Chemicals:	Acids, bases, dry chemicals <b>except</b> outdated drugs and cytotoxic medicine;
Apparatuses:	Electrical or electronic devices, batteries, and in particular thermometers or manometers containing mercury;
Radioactive Material:	Radioactive material of any kind.

## 5.2 Incineration of Waste

*Feed the waste into the cold incinerator!*

The waste should be charged into the cold incinerator in three layers:

- 1<sup>st</sup> layer: plastic and paper waste (sharps container);
- 2<sup>nd</sup> layer: wet bandages, organ parts;
- 3<sup>rd</sup> layer: plastic and paper waste.

**Cytotoxic waste** should be part of the first (bottom) layer to secure that this waste stays in the combustion zone with the highest temperature.

The waste should be packed densely (Picture 33) to avoid the formation of air channels between the lower ash compartment and the upper combustion chamber. However, operators must never try to compress the waste by hand as there is a *grave danger of injuries from infected needles, sharps etc.* Always wear strong leather gloves (part of the shipment) when handling the waste. The incinerator can be filled to a height shortly below the burner position.



Picture 33:

Loaded incinerator before ignition

*Start the diesel burner and ignite the waste using a torch!*

After the waste has been fed to the incinerator, the diesel burner is started. The following procedure has to be followed when starting the burner:

- Close the incinerator doors! The burner will only start if there is no light in the interior of the incinerator.
- Move the traversable burner support frame to the incineration position (Picture 34)!
- Attach burner plug to the socket!
- Check the amount of diesel in the jerry can (the incinerator needs 3-4 l/h) and make sure that the ends of both fuel pipes are properly submerged in the fuel!
- Adjust the air valve at the burner to 50% (Picture 35)!
- Press the start button at the left hand side of the burner (Picture 35)! The fuel pump will start to pump the fuel. After a short while the ignition takes place automatically.

If the burner does not start:

- Wait for 45 seconds, and then press the start button at the burner again! This procedure may have to be repeated several times until all pipes are filled with fuel and no air remains.
- When the burner has started, adjust the air valve to 60-80% (Picture 35)!

To ignite the waste charge, open the upper door of the incinerator. Ignite a piece of cardboard or paper at the burner flame and set the upper part of the waste to fire (Picture 36). Close the incinerator door after controlling that the waste is burning steadily. Make sure that the ash door and the air inlets of the off-gas chamber are shut. Now, the incineration proceeds autogenously.



Picture 34: Burner stand in incineration position



Picture 35: Start button and air valve at the left side of the burner

Picture 36: How to ignite the waste



***Do not open the incinerator doors during the incineration process, unless there is an emergency!***

Unless there is an emergency, do not open the incinerator doors until the major part of the waste has been burned (this will be the case after about 1½ hours). If it becomes necessary to open the upper incineration door while the combustion proceeds, the operator must stand clearly behind the incinerator door when slowly opening the door. **Protective eye goggles and gloves** must be worn (both part of the shipment). Be prepared for flames and smoke to come out of the open door.

Check the burner's operation from time to time. The burner is important to secure a complete combustion of the fumes emitting from the burning waste. Additionally, the burner supplies extra heat in case wet waste does not burn properly. It also acts as a pilot flame to protect the process against autogenous deflagration of combustible gases.

Should the diesel burner shut off for any reason (e.g. lack of fuel) while the incineration is still underway, a special re-starting procedure has to be applied. The burner is equipped with a photocell that shuts off the electrical ignition of the burner when the burner flame burns or when there is fire in the incinerator. To overcome this controlling device, the photocell has to be removed from its normal position (Picture 37) and protected by hand against light while pressing the start button of the burner. Once the burner has started, the photocell is reset to its normal position at the burner.

Picture 37:

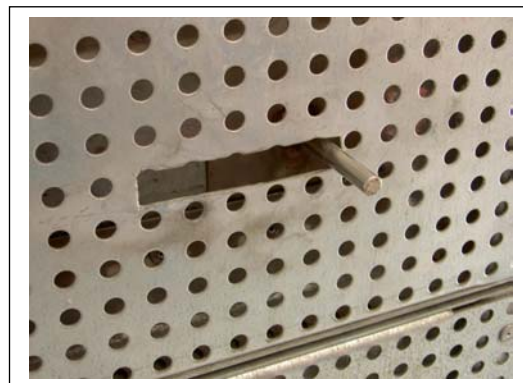
Removal of photocell when starting the burner while incineration in progress



***Open the air inlets in the off-gas chamber!***

Approximately half an hour after starting the incineration process, the air inlets of the off-gas chamber have to be opened (Picture 39). You may see that flames start burning in the off-gas chamber near to the air inlets. That is a sign that there is not enough oxygen in the incinerator to completely burn the off-gas fumes. Through the air inlets additional oxygen is now provided to secure a complete combustion.

Picture 38: Handle to open air inlets



### *Check the off-gas quality!*

Under normal operation conditions hardly any visible smoke should be emitted from the chimney. Some light smoke may exit from the chimney after one hour of operation. This smoke generation will stop by itself after a while.

### *Understand the incineration process!*

To correctly understand the incineration process, it is important to bear in mind that it is not the solids or liquids themselves that burn, but the gases which are produced or set free in the pre-heating zone before the fire zone proper.

Due to the cold starting condition and a lack of combustion air in the lower waste layers, the incineration progress is fairly slow, in particular during the first hour of operation. This leads to a gentle gasification of the waste and a sufficiently long retention time of the combustion gases in the furnace, thus securing an almost complete combustion of all combustibles. During this phase, the off-gas fumes exiting from the chimney are not visible.

After some time of operation the temperature in the furnace increases and the combustion process becomes fiercer. At this stage the gasification velocity increases as well and the retention time of the gaseous products in the furnace is reduced. Although the high temperature in the furnace supports a fast combustion of the gases, the short retention time and in particular the insufficient supply of combustion air (oxygen) may lead to combustibles remaining in the off-gas of the incinerator. During this phase of the incineration, which may last for about half an hour, some traces of smoke (soot) can be seen leaving the chimney. Opening the air inlets in the off-gas chamber will support the combustion in supplying extra oxygen to the incinerator.

When the degassing of most of the volatiles (hydrocarbons) has stopped towards the end of the process, the final incineration is almost smoke free. The remaining waste in the furnace has been converted into a charcoal or coke type of material which burns without smoke. This phase will last for approximately another half an hour.

The share of plastic and paper waste must not be increased beyond the prescribed level of 50-60%. As these materials burn fiercely, the high incineration velocity will result in increased smoke emissions. Never charge any additional waste into an ongoing incineration process or into a glowing hot incinerator.

### *Shut down the incineration process properly!*

A careful inspection of the incinerator after 2 hours of operation through the upper door should show that only some glowing ashes remain in the incinerator. In this case, remove the burner plug from the socket and the burner including the cooling fan will stop. Turn the traversable burner stand into its rest position (Picture 39).

Photo 39:

Rest position of burner during times the burner is switched off but the incinerator is still hot



To protect the burner against overheating it is very important to move the burner stand away from the hot incinerator after shutting down. Since the internal cooling fan was shut off, the hot furnace would otherwise overheat the burner, which could lead to its total damage. The same happens if the burner flame extinguishes unnoticed during operation (e.g. because of lack of fuel). The cooling fan will stop automatically after a few minutes, creating the danger of overheating the burner. **Therefore: Never leave the incinerator unattended while burning waste!**

*Give the incinerator sufficient time to cool down before charging a new batch!*

For reasons explained above, the incinerator should be given at least 3-4 hours cooling time before a new charge is fed to the oven. During the cooling time all doors and air inlets must be closed. The resulting slow and gentle cooling process protects the fire-resistant components of the incinerator and prevents the formation of cracks.

During a day shift of 8 hours, two incineration cycles are possible if the following operation schedule is applied:

Loading and incineration of 1 <sup>st</sup> batch:	2 hours
Cooling time:	4 hours
Loading and incineration of 2 <sup>nd</sup> batch:	2 hours
Cooling time:	over night

### 5.3 Maintenance and Repair

Very little maintenance and repair is needed, but the few recommended measures have to be carried out regularly.

*Remove ash from incineration regularly!*

The ash after incineration has only approximately 1-5% of the volume of the original waste. Therefore it is not necessary to remove the ash after each incineration batch.

Depending on the number of batches and the content of non-burnable components (steel needles, glass), the ash needs to be removed only every second or third day, but at least once a week. Since there is still a danger of mechanical injuries, the personnel should wear protective gloves when removing the ash from the furnace.

***Check for cracks and damage of the fire-resistant incinerator body!***

Cracks in the fire-resistant incinerator body are normal and unavoidable. They result from the heat expansion of the various parts. All ceramic components are reinforced with high temperature resistant steel fibres which give stability to these parts even if cracks appear. Nevertheless, the operation personnel should check and monitor the formation of cracks in the ceramic body each time before starting a new incineration process. The following measures have to be taken to avoid cracks from growing to an unacceptable size.

**Cracks of up to 3 mm** do not need any special measures, but they should be cleaned from ash and dust using a feather, a thin brush or a vacuum cleaner to avoid deposition of these materials in the cracks. Do not fill these cracks with any filler material since this may lead to further damage.

**Cracks of 3-6 mm** should be cleaned as well and filled loosely with fire-resistant wool or fibres. Do not fill up the cracks too densely with the fibres since this may lead to further damage.

If **large parts have broken off** the following repair procedure should be followed:

- a) Remove all loose parts, slag or other impurities from the damaged area!
- b) Clean the surface from any dust!
- c) Moisten the surface with clean water (drinking quality)!
- d) Prepare from a small portion of the water glass cement (RT-1800, Picture 40) a liquid pulp by adding clean water (drinking quality)! The consistency of the pulp is correctly prepared if it is possible to easily coat the damaged surface with a small brush.
- e) Coat the damaged surface with a 1 mm layer of the water class cement pulp!
- f) Prepare from a portion of the Superplast filler material (47-X3, Picture 41) a kneadable plaster by adding a small portion of clean water (drinking quality)! To check if the plaster is of the right consistency conduct the following "ball in hand" test:
  - Form a ball from the plaster!
  - Through the ball approximately 30 cm upwards and catch it again with your hand!
    1. If the ball breaks into pieces the plaster is still too dry.
    2. If the plaster flows through your fingers it is too wet.
    3. If the ball only slightly deforms and stays in one piece, the plaster is of the right consistency.

- g) Attach the plaster to the broken area and model the missing part. It is important to stamp and compact the plaster strongly, maybe by using a wooden stick or spatula.
- h) After modelling of the correct shape smooth the surface of the repaired part (e.g. by brushing with a little amount of water) so that it is in level with the neighbouring original part.

*Note! It is important to work "wet in wet". That means: wet water class cement pulp is attached to a wet incinerator surface while wet Superplast filler is attached to the wet water glass cement layer.*

For storing the water class cement add a small amount of water before closing the cover, so that the surface of the cement in the container is completely covered by water!



Picture 40:  
Water glass cement (RT1800)



Picture 41:  
Superplast filler material (47-X3)

*Check and clean the diesel burner regularly!*

There is very little maintenance work related to the diesel burner. If the burner is always turned away from the furnace after the incineration to prevent overheating, no major damage will occur under normal operation conditions. It is advisable to remove the dust from the inside and the outside of the burner regularly, at least once a week. For the inside cleaning remove the burner cover and clean the interior with a feather or compressed air. Check the jerry can from time to time and remove any sand and solid particles that may have accumulated at the bottom. Otherwise this may lead to a blockage of the burner's fuel system.

*Keep your working place clean!*

Hospital waste poses a danger for the workers at the incinerator. Therefore it is important to avoid waste residues to be scattered in the surroundings of the incinerator. It is advisable to clean the area around the incinerator regularly, every second or third day but at least once a week.

Food or drink must not be kept in the incinerator room and it is strictly forbidden to eat and drink while working at the incinerator.

## 5.4 Security Advices

The most important safety instructions and security precautions are summarised below. They must be strictly observed:

### Selection of incinerator site

- If possible, the incinerator should be installed inside a building which can be locked to prevent unauthorised persons from getting into contact with the hazardous waste.
- The chimney must be kept clear of the roof, in particular if the roof is made of tent cloth or thatch.
- The incinerator building or site should be selected out of the main wind direction so that the smoke of the incinerator is carried away from dwelling areas.

### During assembly of the incinerator

- Workers in charge of the assembly should wear protective gloves to protect their hands.
- 4-6 workers are needed to move the heavy incinerator parts.
- All ceramic parts are quite brittle and have to be moved and positioned carefully to avoid corners or parts breaking off.
- When connecting the burner cable to the plug it is important to make sure that the phase (Ph) is connected to the phase of the mains and the zero conductor (Mp) is connected to the MP of the mains.
- Only metal containers may be used for fuel storage and supply.

### During operation of the incinerator

- The incinerator should always be operated according to the instructions and recommendations of this manual and by authorised and trained personnel only.
- Only medical waste like syringes and needles, one way scalpels and empty ampoules, infusion tubes and open bottles/bags, used plasters, bandages and one way gloves including their packaging are allowed to be incinerated.
- It is not allowed to incinerate explosives, chemicals except drugs, apparatuses and radio active material.
- The operation of an incinerator for hospital waste may need a special permission by the local authorities in the respective country. It is the User's responsibility to obtain the required permissions.
- When working at the incinerator the workers have to wear safety goggles and leather gloves.
- It is not allowed to compress the waste in the incinerator by hand.
- After the incineration has started, the front doors have to be kept closed.
- If the upper incineration door has to be opened in an emergency while the combustion proceeds, the operator has to stand clearly behind the incinerator door when slowly opening the door.
- No fresh waste must be charged into a hot furnace.
- When the burner flame extinguishes, the burner stand has to be moved away from the incinerator immediately if not restarted again.
- Never leave the incinerator unattended while burning waste.

- When removing the ash from the ash chamber, protective gloves have to be worn.
- It is important to carry out maintenance and repair works regularly and to keep the working area clean.
- No food or drink must be stored in the incinerator room and it is strictly forbidden to eat and drink while working at the incinerator

## **Annex: Technical data sheets**

[Technical data of fire-resistant ceramic mass of HWI-4](#)

**Feuerleichtbeton "Isoplast"**
**RSCAST LB - 03 - 40 - 0**

**Allgemeine Eigenschaften**      Extra leichter Beton mit guten Isoliereigenschaften und hoher mechanischer Stärke. Ein RS- Produkt für hoch belastete Fertigteile sowie ein Alternativ für keramische Fasern und Isoliersteine Gruppe 26.  
 General Properties

**Klassifikation** : Feuerleichtbeton  
 Classification

Anwendungsgrenztemperatur :                      1.400 °C  
 Max. service temperature

Bindungsart :      hydraulisch                                      Rohstoffbasis :      Leicht-Schamotte  
 Type of setting                      hydraulic                                      Raw material base

Rohdichte :      880 kg/m<sup>3</sup>                                      Materialbedarf :      0,93 t/m<sup>3</sup>  
 Bulk density                                      Required material

Verarbeitung :      Gießen, Spritzen                                      Wasserzusatz :      7,8-8,4 Ltr./Sack  
 Application                                      cast, gunning                                      Addition of water                                      by casting

Körnung :      0 - 5 mm  
 Grain size

**Chemische Eigenschaften**                      Al<sub>2</sub>O<sub>3</sub> :      43,0 %                      Fe<sub>2</sub>O<sub>3</sub> :      0,9 %  
 Chemical Properties                      SiO<sub>2</sub> :      38,0 %                      CaO :      15,2 %

**Physikalische**
**Eigenschaften**

Physical Properties

Temperatur temperature	bleibende Längenänderg. permanent linear change	thermische Dehnung thermal expansion	Kaltdruckfestigkeit cold crushing strength	Wärmeleitfähigkeit thermal conductivity
°C	%	%	N/mm <sup>2</sup>	W/mK
110	-0,05		6,0	0,22
400				0,230
800	0,05		3,5	0,250
1000	-0,2		3,5	0,290
1200	0,8	0,6	3,3	
1400				

**Verpackung** :      15 kg      Säcke                      **Anlieferungszustand** :      Trocken  
 packaging                                      condition at delivery

**Lagerfähigkeit** :      12 Monate  
 shelf life

**Anmerkung** :      Produktion von Allesbrennern, Schaulöchern, Laboratoriumöfen,

Remarks                      für Gasbrenner, Bekleidung von Decken- und Wandpaneele usw.  
    Als Spritzmasse auch für Reparaturen von bestehenden Faser- und Isolierstein-  
    auskleidungen, Neuzustellung von Ofendecken und Wänden usw.

Die Daten sind Durchschnittswerte aus Laboruntersuchungen. Sie unterliegen den in der Grobkeramik produktionsbedingten Toleranzen und stellen keine Zusicherung von Eigenschaften dar. / These data are mean values from lab-examinations. They are subject to the tolerances dependent

<b>Dichter Feuerfester Beton</b>		<b>"Superplast - 47 - X3"</b>		
<b>Allgemeine Eigenschaften</b> General Properties		Rev. B 26. Febr. 2004		
<b>Klassifikation</b> : Feuerbeton für Reparaturarbeiten Classification				
Anwendungsgrenztemperatur : Max. service temperature		1.470 °C		
Bindungsart Type of setting	: hydraulisch hydraulic	Rohstoffbasis Raw material base	: High alumina raw- materials	
Rohdichte Bulk density	: 2,35 kg/dm <sup>3</sup>	Materialbedarf Required material	: 2,4 t/m <sup>3</sup>	
Verarbeitung Application	: Spritzen/Gießen/Schmieren Anwerfen/Aufsetzen	Wasserzusatz Addition of water	: nach Bedarf	
Körnung Grain size	: 0 - 7 mm			
<b>Chemische Eigenschaften</b> Chemical Properties		Al <sub>2</sub> O <sub>3</sub> : 51,0 %	Fe <sub>2</sub> O <sub>3</sub> : 1,2 %	
		SiO <sub>2</sub> : 41,0 %	CaO : 5,0 %	
<b>Physikalische Eigenschaften</b> Physical Properties				
Temperatur temperature	bleibende Längenänderg. permanent linear change	thermische Dehnung thermal expansion	Kaltdruckfestigkeit cold crushing strength	Wärmeleitfähigkeit thermal conductivity
°C	%	%	N/mm <sup>2</sup>	W/mK
110	0,1		15,0	
400				0,910
800	-0,30			
1000	- 0,50	0,62	13,0	
1200				
1400	- 0,30		22,0	
<b>Verpackung</b> packaging	: 25 kg Säcke	<b>Anlieferzustand</b> condition at delivery	: Trocken	
<b>Lagerfähigkeit</b> shelf life	: 12 Monate			
<b>Anmerkung</b> Remarks	: Sehr plastische, gut klebende Reparaturmasse für die Reparatur von feuerfesten Konstruktionen aus Stein, Stampfmassen, Beton usw. . Vielseitige Verarbeitungsmöglichkeiten (Stampfen, Spritzen, Gießen, Aufsetzen, Schmieren, Anwerfen). Einfach flach und straff abzarbeiten. Durch Zufügung spezieller Additive sehr wenig Verarbeitungsverluste.			
Die Daten sind Durchschnittswerte aus Laboruntersuchungen. Sie unterliegen den in der Grobkeramik produktionsbedingten Toleranzen und stellen keine Zusicherung von Eigenschaften dar. / These data are mean values from lab-examinations. They are subject to the tolerances dependent on the production in ordinary ceramics and do not represent a warranty for the material characteristics.				

Superplast filler material for repair works