

Profile LFR-34

FRETHME

GERMANY

GENERAL INFORMATION

NAME OF THE FACILITY	Fretting Tests in Heavy Liquid Metal
ACRONYM	FRETHME
COOLANT(S) OF THE FACILITY	PB, LBE
LOCATION (address):	Karlsruhe Institute of Technology (KIT) Institute for Pulsed Power and Microwave Technology (IHM) Hermann-von-Helmholtz-Platz 1, Bldg 630 76344 Eggenstein-Leopoldshafen Germany
OPERATOR	KIT
CONTACT PERSON (name, address, institute, function, telephone, email):	Dr. Georg Müller Karlsruhe Institute of Technology (KIT) Deputy Institute Director +49 721 608 24669 georg.mueller@kit.edu

STATUS OF THE FACILITY	In operation
Start of operation (date):	2010

MAIN RESEARCH FIELD(S)	<input type="checkbox"/> Zero power facility for V&V and licensing purposes
	<input type="checkbox"/> Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
	<input type="checkbox"/> Thermal-hydraulics
	<input type="checkbox"/> Coolant chemistry
	<input checked="" type="checkbox"/> Materials
	<input type="checkbox"/> Systems and components
	<input type="checkbox"/> Instrumentation & ISI&R

TECHNICAL DESCRIPTION

Description of the facility

FRETHME facility is employed for fretting tests in liquid lead alloys. Three samples can be simultaneously tested at fixed amplitude with different loads. All relevant parameters such as liquid metal conditions, load, motion amplitude and friction force are recorded. The FRETHME facility was designed to simulate experimentally the fretting corrosion process in heavy liquid metals at reactor relevant conditions.

The control of temperature and oxygen content in the liquid lead/lead alloy, determinant parameters for the corrosion/oxidation kinetics, is achieved by appropriate heating and gas supply systems. In addition, the main parameters affecting fretting, such as applied load, frequency, amplitude of the slip and friction force, are controlled and constantly monitored using dedicated sensors and adequate software for data collection and processing.

The oscillatory fretting motion is simulated by coupling a fixed counter specimen under load with a sliding specimen, by this way creating a friction or fretting pair. The specimens for the fretting test are cylinders with external diameter of 9.5 mm and a thickness of 0.5 mm. The counter-specimens are 2 mm thick plates, shaped in order to have a maximum contact surface of 8 mm². Alternatively a wire wrap configuration is available at which the specimen is a tube section and the counter specimen is a wire welded to a specimen holder both in point contact.

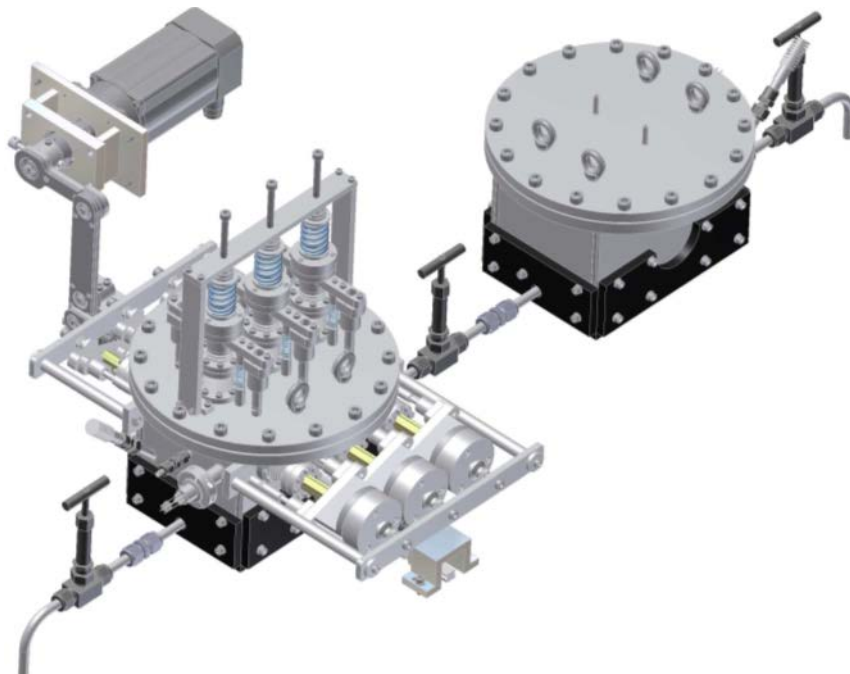
Main research interest of FRETHERM is:

- Fretting corrosion of cladding materials in stagnant Pb and PbBi
- Effects of frequency, amplitude, temperature, oxygen content, load on fretting corrosion

Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo



Parameters table

Coolant inventory	2l
Power	n/a
Test sections: 3	
TS #1-3	<u>Characteristic dimensions</u> Specimen size: cylindric with 9.5mm diameter, 0.5mm height
	<u>Static/dynamic experiment</u> static
	<u>Temperature range in the test section (Delta T)</u> up to 650°C isothermal
	<u>Operating pressure and design pressure</u> ambient
	<u>Flow range (mass, velocity, etc.)</u> Applied load up to 100N Load frequency up to 40Hz Load amplitude 5µm - 500µm
Coolant chemistry measurement and control (active or not, measured parameters)	Active oxygen control via gas phase and oxygen sensors in the liquid metal
Instrumentation	Temperature Oxygen content Load Friction force Amplitude Frequency

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

PhD. of Mattia Del Giacco funded by EU GETMAT project: " Investigation of Fretting Wear of Cladding Materials in Liquid Lead":

T91, 316 and FeCrAl surface alloyed T91 in Pb at temperatures between 400 and 550°C, amplitude between 5 and 200 µm, load up to 100N, depending on parameter severe friction wear

Test in PbBi with modified geometry (Wire wrap in point contact)– was adapted to MYRRHA design-specimen and counter specimen 15.15Ti 20%cw (cold worked)

PLANNED EXPERIMENTS (including time schedule)

Test in PbBi with spacer grid geometry– with ODS and 15-15Ti at 550°C

TRAINING ACTIVITIES

Training activities are possible, depending on availability and after prior agreement under supervision of KIT.

REFERENCES (*specification of availability and language*)

M. Del Giacco, A. Weisenburger, G. Mueller: Fretting corrosion in liquid lead of structural steels for lead-cooled nuclear systems: preliminary study of the influence of temperature and time. Journal of Nuclear Materials, 423(2012) S.79-86

Del Giacco, M.; Weisenburger, A.; Mueller, G. Fretting corrosion of steels for lead alloys cooled ADS. Journal of Nuclear Materials, 450(2014) pp.225-236