3.10. KAJET - Karlsruhe Jet Experiments

Experiments on the interaction of a pressurized melt jet with different types of concrete

Objective of the facility

The experimental programme named KAJET is being performed to investigate features of a pressurized melt jet and the interaction with substratum material. Compact melt jets, rather than a spray-type melt release, are simulated using iron and aluminium oxide instead of corium. The melt is generated by a thermite reaction. The experiments provide general information about erosion processes and data for the validation of computer codes (or, if possible, simplified correlations) which then are able to transfer the results to reactor conditions.

Parameters of the facility

The KAJET erosion test facility is shown in Fig. 10-1. Total melt masses of up to 300 kg can be provided by various types of melt generators. Driving pressures of up to 2.5 MPa can be established. Melt release occurs downward into a vessel which is 1100 mm in diameter and 1900 mm in height and has at its bottom layers of gravel and sand. The pressure inside the vessel can be raised up to 0.3 MPa. The examined samples consisted of siliceous concrete and borosilicate glass concrete.

The schematic (Fig. 10-2) helps to explain how the test was conducted. The time scale begins with the start of ejection. The first melt component to be ejected on sample no 1 was iron. Shortly before the end of iron release, the plate carrier was turned by 90° within one second. During that time, the melt changed to oxide as the component to be ejected on sample no 2.

Instrumentation and measurements

The test plates were 100 mm thick and consisted of different concrete. Each plate was instrumented with thermocouples arranged in horizontal levels at distances of 5 to 40 mm from the upper surface (Fig. 10-3). With progressive erosion the melt reached the thermocouples in the different depths. With contact to the melt, the thermocouples gave a signal which was assigned temporally. The temperature of the jet was measured by a pyrometer during the release.

Results

In summary, five KAJET erosion experiments were performed. The erosion rates within the examined range are about 8-12 mm/s for iron jets and 6-11 mm/s for oxide jets in case of siliceous concrete, and increases with the driving pressure. The erosion rates are a little bit smaller for concrete fabricated with aggregates from borosilicate glass.

Table 10.1 KAJET test matrix

Exp. ID	Date	Type (characteristics)
KJ01	April 1998	Discharge of 40 kg of thermite melt to investigate the shape of the melt jet and to test the facility for the erosion experiments. Driving pressure 1.5 Mpa, duration ~ 5.5 s.
KJ02	March 1999	Discharge of 40 kg of thermite melt on siliceous concrete. Driving pressure 0.3 Mpa, duration ~ 5.5 s.
Kj03	September 1999	Discharge of 112 kg of thermite melt on siliceous concrete. Driving pressure 0.5 Mpa, duration ~ 13 s.
KJ04	April 2000	Discharge of 83 kg of Al_2O_3 melt on siliceous concrete. Driving pressure 0.5 Mpa, duration ~ 10 s.
KJ05	August 2000	Discharge of 104 kg of thermite melt on borosilicate glass concrete. Driving pressure 0.5 Mpa, duration ~ 10.6 s.
KJ06	February 2001	Discharge of 115 kg of thermite melt on borosilicate glass concrete. Driving pressure 0.4 Mpa, duration ~ 11.9 s.
KJ07	August 2001	Discharge of 152 kg of thermite melt on borosilicate glass concrete. Driving pressure 0.8 Mpa, duration ~ 10.2 s.
KJ08	March 2002	Discharge of 159.5 kg of thermite melt on siliceous concrete. Driving pressure 0.8 Mpa, duration ~ 8.7 s.

Table 10.2 KAJET Documentation

EDR	G. Albrecht, W. Schütz – SAM-ECOSTAR-D10, Experiments KJ02-KJ05	KAJET-D10.pdf	0.5 MB
EDR	G. Albrecht, W. Schütz – SAM-ECOSTAR-D11, Experiments KJ06-KJ07	KAJET-D11.pdf	0.5 MB
EDR	G. Albrecht, W. Schütz – SAM-ECOSTAR-D12, Experiment KJ08	KAJET-D12.pdf	0.4 MB

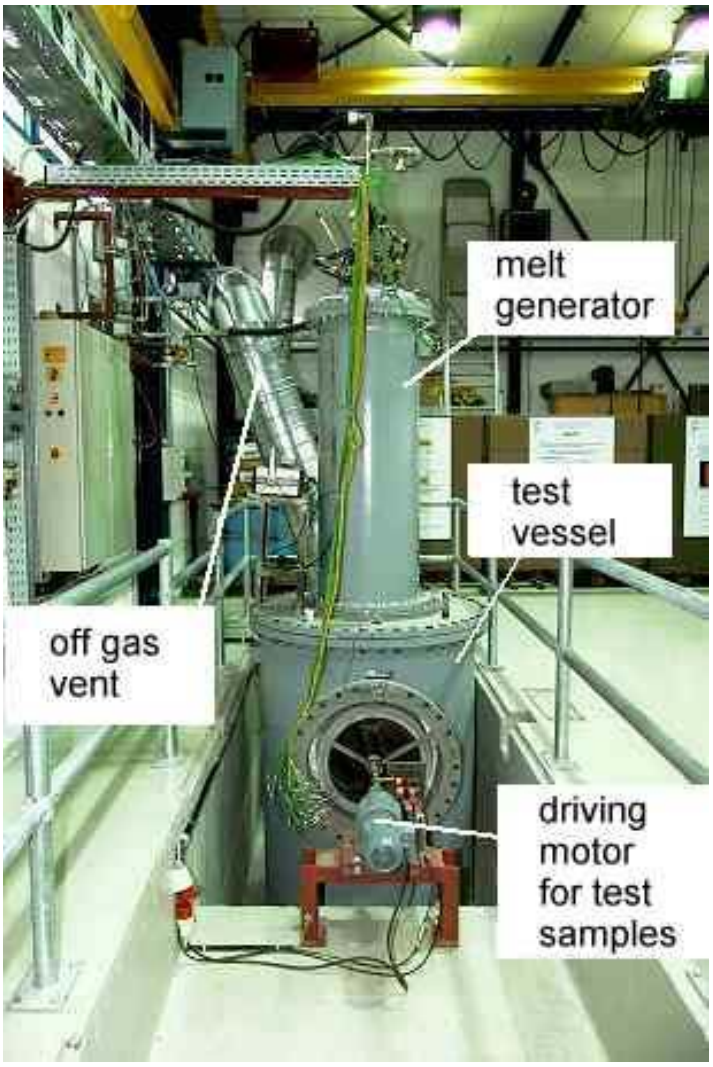

Fig. 10-1 View of KAJET test facility

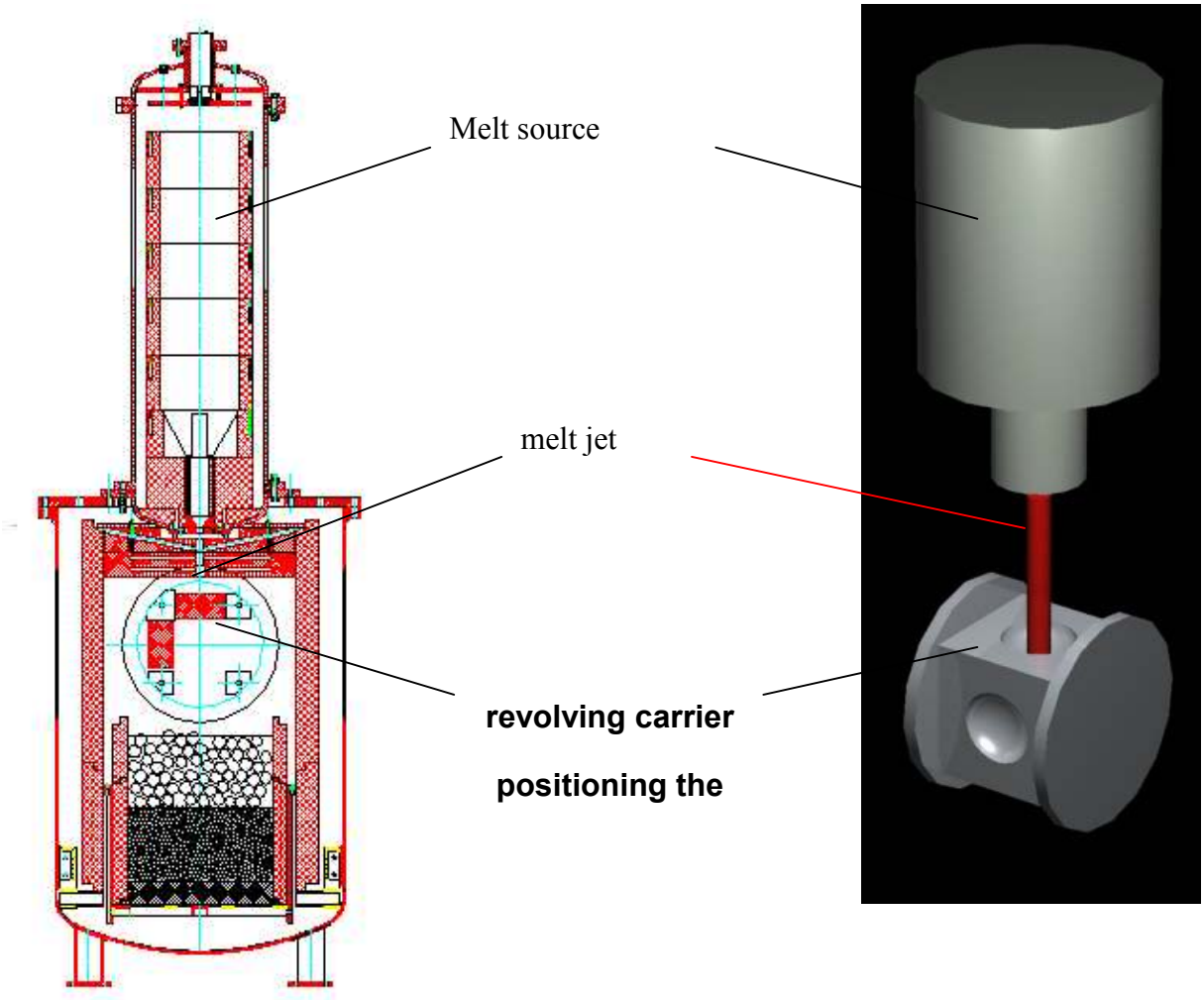

Fig. 10-2 Scheme of the KAJET facility

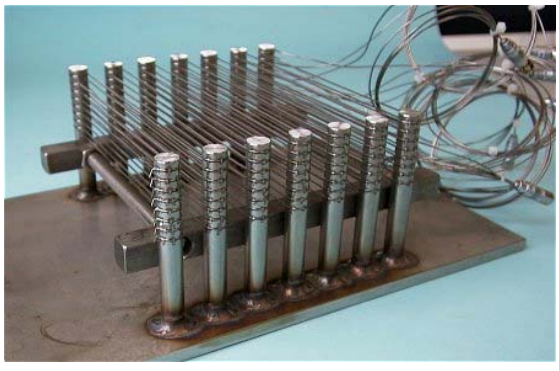

Fig. 10-3 Instrumentation of the samples.

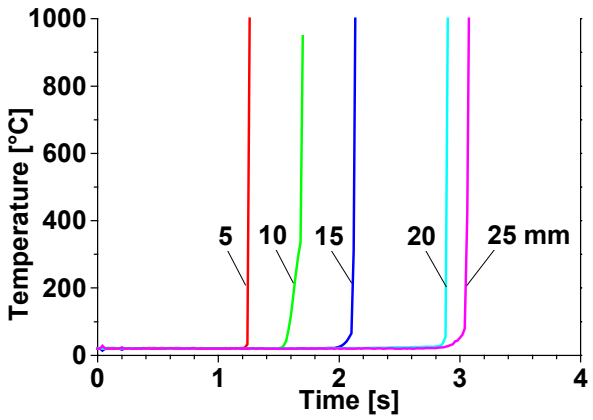

Fig. 10-4 Signals of thermocouples