MANAGING THE SECURE TRANSPORT OF CRYOSTORAGE TANKS

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BACKGROUND

The safe transport of entire cryopreserved sample collections is logistically and technologically challenging.
Here, we evaluate the relocation of entire cryostorage tanks containing cryopreserved sample collections. The samples were stored in the gas phase of liquid nitrogen within the tanks and were shipped using improved state-of-the-art transport systems and surveillance technology. For data analysis we logged the temperature within the cryostorage vessels and measured vibrations affecting the vessels during the transport.
Our intention was, to establish a secure relocation system of entire cryostorage tanks containing cryopreserved sample collections with closed cooling chain and minimized external impacts to prevent any changes in the cryopreserved samples.

Fig. 1: Cryostorage vessels. **A**: Cryostorage tank, technologically modified with hover cushion brackets; **B**: Cryostorage tanks, technically modified with vacuum isolation stabilizers, clamped in HGV.

METHODS

To evaluate the shipment of entire cryopreserved sample collections we redesigned the whole transport process. Technologically optimized cryostorage vessels (see Fig. 1) were equipped with sensors recording the temperature within the vessels and the vibrations affecting the tanks.
In practice, technologically modified cryostorage tanks with air cushion systems for transport and vacuum isolation stabilization systems were equipped with the control devices Biosafe Control-ß and Adur-ß to measure and log the temperature. During the shipment, vibrations were logged by the device National Instruments NI DAQ-Pad-6251 Pinout, which was fixed to the cryo vessels.

LITERATURE
(1) Committee on Germ Plasm Resources, 1978. Conservation of germplasma res.: An Imperative 7: 79-84
(2) Burdon 1999, http://www.btc-bti.com/applications/cryogenicstorage.htm

RESULTS

Analysis of the temperatures (see Fig. 2) appearing during the transport indicate, that the samples were constantly stored below -150°C within the gas phase of liquid nitrogen, which is clearly in the range of save cryostorage temperatures. Throughout the whole relocation process this temperature range ensures that chemical processes in the samples are reduced to a minimum and morphological changes are prevented (1). In addition the inert-gas atmosphere created by the nitrogen evaporation prevents any changes in the samples caused by oxygen from the atmosphere (2).
Analyses of the vibrations (see Fig. 3) appearing during the transport indicate, that there was no significant external impact on the samples during the transport. Thus adverse effects on the cryopreserved samples induced by vibrations can be almost certainly excluded.

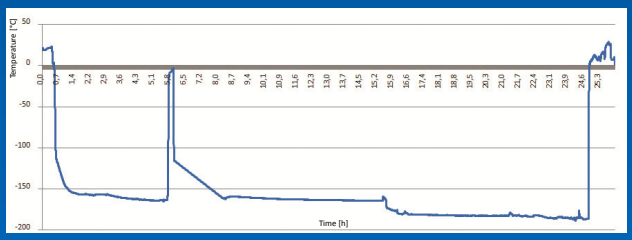

Fig. 2: Temperature profile chart [°C/h]. Analysis of the temperature (Biosafe Control β) appearing during a transport of samples in a cryo tank. Reasons for temperature changes: 1. From -20°C – installation of sensor in cold tank. 2. From -150°C – transport of tank to the place of sample relocation – temp. constant. 3. Sudden temperature change to 0°C – samples transferred to bin. 4. Initial temperature of samples is -120°C. According to thermal transmission coefficient and thermal capacity the samples cool down to tank temperature. 6. Removal of samples.

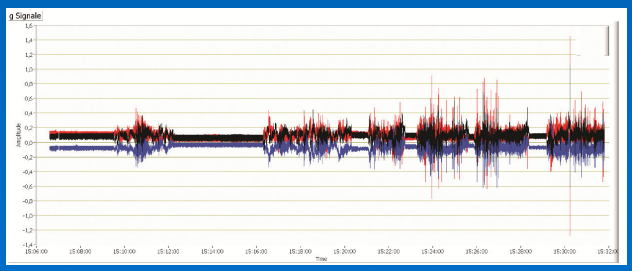

Fig. 3: Vibration chart. Acceleration signals in three directions. Signals of the sensors: Blue line: Vertical acceleration; red line: Lateral acceleration (e.g. curves); black line: Braking / accelerating. During the shipment, vibrations were logged by the device National Instruments NI DAQ-Pad-6251 Pinout. This device was fixed to the cryostorage vessels by a force-locked connection. Analysis of vibrations affecting the vessels during a transport of samples from Berlin to Sulzbach indicate, that there was no significant external impact on the samples during the transport.

SUMMARY

The relocation system of whole cryostorage tanks established by the BioKryo GmbH and the Fraunhofer IBMT is an optimal way to guarantee a secure transport of cryopreserved samples including closed cooling chain and minimized external impacts.

BioKryo GmbH offers cryostorage of valuable therapeutical and diagnostical biological samples, like stem cells and tissues. As a spin-off of the Fraunhofer-Institute for Biomedical Engineering (IBMT), the BioKryo GmbH profits from a 10 year-experience in cryotechnology and stem cell research. The BioKryo GmbH is ISO 9001:2008 certified and possesses a manufacturing license according to § 20c AMG for the storage of e.g. tissues or therapeutic stem cell lines and is therefore able to provide a GMP compliant storage service.

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