MEAB

The AKUFVE System

Micro-SISAK - A Micro-SCALE, MULTISTAGE MIXER-(CENTRIFUGAL)SETTLER ARRANGEMENT

The SISAK solvent extraction system is used in radiochemistry for the continuous separation of short-lived isotopes. The procedure is based on multi-stage solvent extraction units applying specially designed centrifuges for fast phase separation. The hold-up time per stage is short and offers the opportunity to rapidly perform efficient chemical separation procedures.

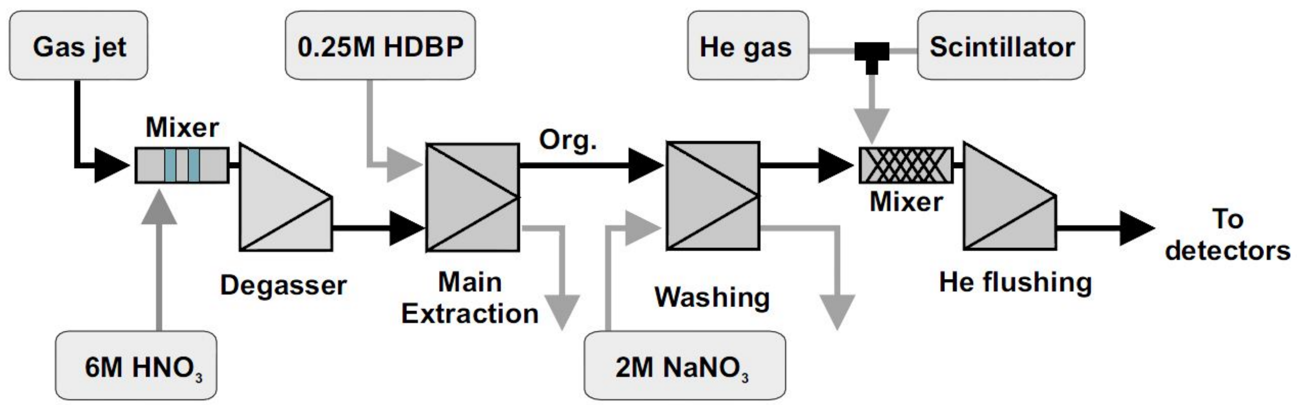
The equipment has in the past years been improved to gain access to shorter half-lives, to use more complex chemical systems and to decrease the amount of liquids used. In the beginning H-10 centrifuges were used, similar to the units used in the small-scale multi-stage mixer-(centrifugal)settler processing units. Today a new micro-SISAK system that consists of smaller and faster H-centrifuges is in operation.

Table 1. **H-centrifuges used in the SISAK system**

Type	Volume (ml)	Max flow-rate (ml/s per phase)	Hold-up time (s)
Centrifuges			
H-33	120	25	2.40
H-10	12	15	0.40
H-0.3	0.3	3.3	0.05
Degassing unit			
HG-0.1	0.1	3.3	0.03

The micro-SISAK arrangement as shown in the figure below, contains degassing units to separate the gases from the liquid and centrifuges for rapid separation of the two liquid phases. An arrangement is shown in figure 1 and described in detail in ref. 2.

Figure 1.
A schematic diagram of the micro-SISAK system.



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The H-0.3 Centrifuge for Separation of Liquids

The two-phase mixture enters the H-0.3 centrifuge and is accelerated to the speed of rotation within the inlet chamber. Then, the mixture flows into the separation volume where it separates in a light phase, discharged through an upper collecting chamber, and a heavy phase, discharged through a lower chamber. Stationary pump wheels, individually designed to provide the appropriate pressure and to avoid excessive frothing of the liquids, discharge the liquids. The outlets are equipped with valves, the purpose of which is to maintain a proper pressure balance in the centrifuge. The flow capacity and phase purity of the H-0.3 centrifuge has been carefully tested with many kind of organic/aqueous mixtures. In all cases good phase separation could be obtained from flow-rates of 0.1 ml/s per phase up to about 3.3 ml/s per phase. The optimal speed of rotation depends on the flow-rate and varies between 20,000 to 35,000 rpm.

HG-0.1 Degassing Centrifuge

The mixture of gas and liquid, mixed together in the static mixer, enters centrally the inlet chamber and is accelerated to the speed of rotation. Then, the mixture is forced through three holes upwards into the separation volume, where it flows downwards into the liquid collecting chamber. A stationary pump wheels pumps the liquid out of the degasser via a throttle valve. The purpose of this valve is to maintain a proper pressure balance in the centrifuge so that the gas does not escape through the liquid phase outlet. The gas is pressed towards the centre of the centrifuge. It is discharged via an outlet surrounding the central shaft and then fed out into the exhaust system. The efficiency of the degassing centrifuge was tested with activated neon gas. The gas was transported in a nitrogen flow and mixed with water. The activity in the liquid phase leaving the centrifuge was measured on-line and no activity could be observed. By knowing the production rate of active neon, the efficiency was calculated to be better than 99.5 %. This was confirmed using fission noble gases in a gas-jet transportation system.

Motor Arrangement

Both the centrifuges are driven by 3-phase asynchronous motors that are powered by AC current of continuously variable frequency (30-750 Hz). The speed of rotation at normal running conditions is 20-30,000 rpm. The power consumption is ca 100 W at maximal load.

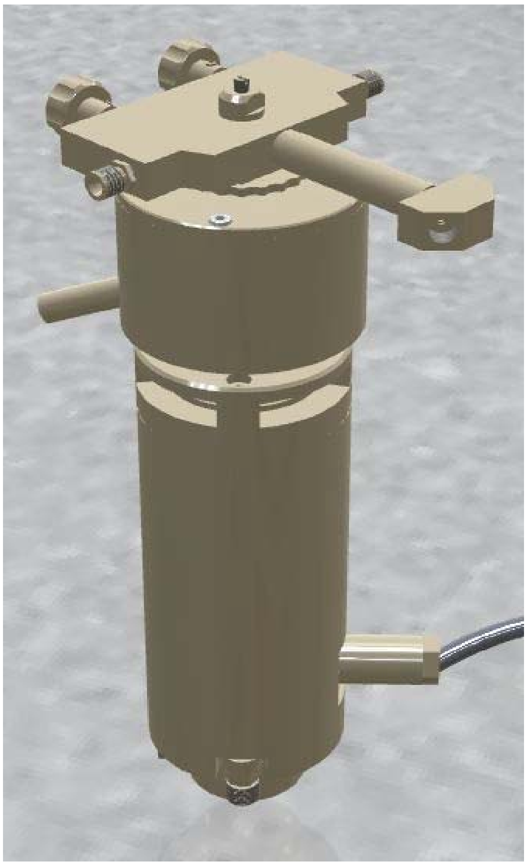

Figure 2. The H-0.3 made in PEEK.

Material of Construction

The original choice of construction material was titanium, passivated with palladium (0.2 %) that make the centrifuges resistant to most solutions. Nowadays, the equipment can also be made in PEEK, a fluoro carbon plastic.

Auxiliary Equipment

Special designed flow meters and pumps are available on request. Also a complete control system for a set-up according to figure 1 can be provided.

References

1. H Persson et al, Radiochimica Acta **48** (1989) 177
2. J P Omtvedt et al, J. Nucl. Radiochem. Sci., Vol 3, No 1 (2002) 121
3. J P Omtvedt et al, Eur. Phys. J. D,**45** (2007) 91