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Laboratory Balances PCE-BS 3000 Application Report

The Working Group Didactics of Physics and Astronomy of the Friedrich Schiller University educates student teachers in the second academic year in the field of physical school experiments and operates at the same time a physical student lab. This is an extracurricular learning center, which may be visited by the whole classes from the surrounding regions to conduct experiments there. For teacher training and student lab we use the analytical balance PCE-BS 3000.

At the currently prevailing high summer temperatures cool beverages make life more bearable. But why do we actually cool our beverages with ice cubes? The answer is a big fusion heat (melting heat) of ice, which means that for the phase conversion from solid to liquid a lot of energy is needed. In a thermo container, e.g. a drinking cup (see. Fig. 1) it is possible to study this quantitatively. Important measured values are the mass of ice and the mass of the liquid already present in the drinking cup. Both can be determined precisely with the help of the analytical balances. The combination of large weighing range (max. 3000 g) and a sufficient accuracy (accuracy 0.1 g) is especially important for school experiments. Further advantages are simple and self-explanatory operation of the laboratory balances and their illuminated and thus easy to read display.

Fig.1 – Determination of the ice fusion heat with the help of the analytical scale PCE-BS 3000

If to mix the same amounts of the hot boiling water (100°C) and cold water (0°C), one expects to get the mixture of 50°C. In the experiment the temperature of

Fig. 2 – Determination of the calorimeter constant of the thermo cup

the mixture is always lower, because the container itself, in which both liquids are mixed, inevitably takes some part of the thermal energy. This effect must be considered in all calorimetric measurements. Quantitatively, this happens because of the so-called calorimeter constant, for the determination of which accurate temperature measurements and weighing of the mixed liquid quantities are required (see. Fig. 2). For the use in the classroom different containers can serve as calorimeters: self-made versions produced of the isolated beakers, coffee cups made of Styrofoam, outdoor thermo cups or expensive manufactured calorimeters that can be found in the teaching materials trade.

If the calorimeter constant is determined once, then numerous physical experiments in the field of thermodynamics are possible: as already described the determination of the specific fusion heat of ice, but also the specific heat capacity of liquids and solids (see Fig. 3), or the specific solutions heat of various salts (see. Fig. 4). All experiments are dependent on an accurate determination of the masses and temperatures.

Fig. 3 – A student determining the heat capacity of the alcohol

Fig. 4 – A student is weighing $CaCl_2$, the solution heat of which should be determined

Another school experiment is determination of the specific water vaporization heat.

For this purpose, you bring the water in a calorimeter with a heater immersed - directly on the scale – to boiling and stop the time, in which a certain amount of water has evaporated. The energy required for the phase conversion follows from the time and the power of the immersed heater. The core of this measurement also here is such Laboratory balances as PCE-BS 3000, which combines high accuracy, high weighing capacity and good handling.

With friendly greetings,

Silvana Fischer Stefan Völker