What is PCV?

PCV or Packed Cell Volume describes the volume that is occupied by a cell pellet after centrifugation. A PCV of 0,1% means that 1 ml of cell pellet is expected per 1 liter of cell culture, respectively 1μl per 1 ml sample (1 μl cell pellet = 1 mg wet biomass)

What is the unit of the novel PCV tubes?

The volume of the cell pellet is measured in μl. This value can be directly read from the calibrated capillary. It depends on the cell density and the sample volume. Dividing it by the sample volume yields % PCV. For example reading 4 μl for a 400 μl sample corresponds to 1% PCV (4μl /400μl = 1 %). The % PCV value linearly correlates with the cell density.

Should the % PCV be converted into a cell number per ml?

The % PCV is an absolute value that can be measured rapidly and without the need of calibration curves or conversion factors. The % PCV value is proportional to the cell density: a cell culture of 1% PCV yields after a 10-fold dilution a density of 0,1% PCV and cell growth results in an increase (see figure 1). Thus the % PCV value can be used the same way as "cell number" and a conversion into cell number is not necessary. For certain studies (e. g. measuring specific consumption rates, working with cell extracts etc.) % PCV might even be the better choice than cell number, which is sensitive to the actual size of the cells. However, sometimes a conversion into cell number is convenient (see below).

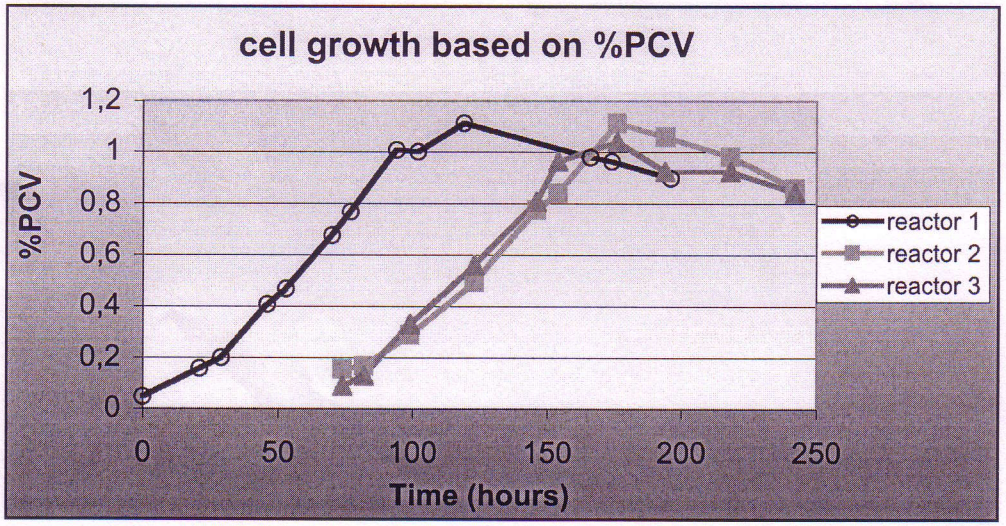

Fig. 1: Growth curve of CHO cells in bioreactors obtained by mini PCV tubes from TPP. Samples were centrifuged during 1 minute at 2500 g in a swing bucket rotor before reading the packed cell volume. The maximum cell density as measured by the trypan blue method was about 8 million cells per ml.

Are dilutions needed?

No dilutions are necessary! If the packed cell volume exceeds the capacity of the capillary (e.g. for a 1 ml sample this is the case if the % PCV is higher than 0,5%),

then the sample volume has to be reduced. Smaller sample volumes are used to analyze cultures with higher cell densities without an upper limitation.

How is PCV converted into a cell density (cells per ml)?

Even if % PCV can be used as an independent parameter, it is in most cases helpful to convert it into a cell density. The conversion can be done by a simple multiplication once the number of cells that fit into 1 µl of cell pellet is known. There are two options to figure out this value.

Option A: The average cell diameter is known. Then the correlation of figure 2 can be used. It can be assumed that the average cell diameter is approximately constant during the growth phase as long as the culture conditions are not drastically changed. Significant differences exist between cell lines and sometimes even among cell clones.

Option B: Generally the diameter of the cells is not known. In this case an accurate cell count is needed and a sample from the same culture is centrifuged into a PCV tube. Knowing the cell density, the number of cells per µl of pellet can be figured out easily. This number is used to convert % PCV into a cell number for unknown samples. In addition, this number gives information about the average cell diameter (figure 2). Thus measuring the PCV and counting the cells for the same sample is a) sufficient to estimate the conversion factor between PCV and cell density and b) also yields information about the average cell diameter.

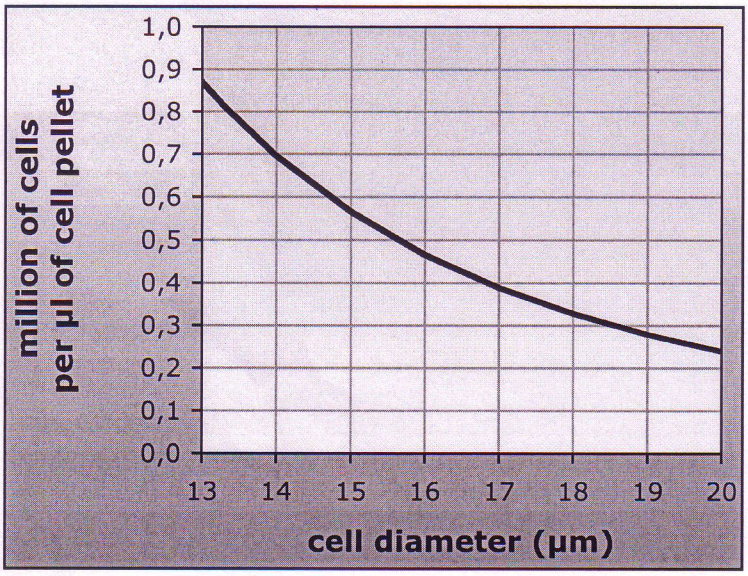

Fig. 2: Correlation between the average cell diameter and the number of cells fitting into a 1 µl cell pellet. The actual number of cells fitting into a given volume can be estimated based on the diameter of the cells. Since most cell lines differ in their diameter, 1 µl (or 1 mg of cells) not always corresponds the same number of cells. For cells with an average cell diameter of 14 µm, each µl of cell pellet would contain 0,7 million cells.