Ultrafiltration

Ultrafiltration is when a hydrostatic pressure forces a liquid through a semipermeable membrane. This is pretty much what happens at the membrane of the glomerulus. Ultrafiltration rate depends upon transmembrane pressure and ultrafiltration coefficient.

**Transmembrane pressure**

Seeing as the main driving force for this process is the applied pressure, one can surmise that it is also the main determinant of the filtration rate.

\[
\text{TMP} = \frac{P_a + P_v + P_s}{2}
\]

TMP in this being the Trans-Membrane Pressure; normally ~ 200-500 mmHg. Obviously, it's the net pressure on the membrane, where the "arterial" access pressure is strongly positive, and the "venous" outflow pressure is feebly positive (or actually zero). If one were so inclined, one could also apply a negative sucking pressure to the venous outflow, thereby increasing the total gradient.

**Ultrafiltration coefficient**

This is the efficiency of the hemofilter; i.e. how easily the fluid moves through a given membrane. It is also known as the "membrane hydraulic permeability". It is the relationship of volume removed to pressure applied; thus, it is measured in mls per hour per mmHg of pressure.

\[
K_u = U_c \times (\text{TMP} - I_p)
\]

A low KUf means a lower permeability to water, and thus higher pressure is required to produce the same amount of ultrafiltrate.

Purely diffusion-based hemodialysis machines also achieve some ultrafiltration, purely because they also have pumps, and these pumps generate a transmembrane pressure gradient.