Experiment apparatus

1.Experiment apparatus of the water level difference experiment using the charge-type electrostatic field method As shown in Figure 1.

The main part of the experimental apparatus: A 14mL multi-port microbial reactor is mainly composed of acrylic blocks with screw holes at the four corners, with three hollow blocks in the middle, and two solid blocks at both the left and the right side. A screw rod is used to pass through the screw hole to string together five acrylic blocks to form a hollow cavity.Two semipermeable membranes divide the hollow cavity into three compartments.

Semipermeable membranes: FFM Technology (Beijing) Co., Ltd. The left side of the device is the RO membrane and the right side is a nanofiltration membrane,all are 28mm diameter round pieces. The model of RO membrane is FFM-FR, with a retention molecular weight of 100 daltons and uncharged. The model of nanofiltration membrane is FFM-NL, with a retention molecular weight of 300-500 daltons and negatively charged.

Transparent rubber tubing: with a 5mm inner diameter.

Solvents: Purified drinking water on the market.

Solute: $C_6H_5Na_3O_7$、Na_2SO_4. Tianjin Zhiyuan Chemical Reagent Co., GB/T9853-2008, Analytical grade.

Solution: self-prepared solution, with a concentration of 0.5% to 1.5%.

Concentration meter: Xiaomi TDS detection pen, model XMTDS01YM.

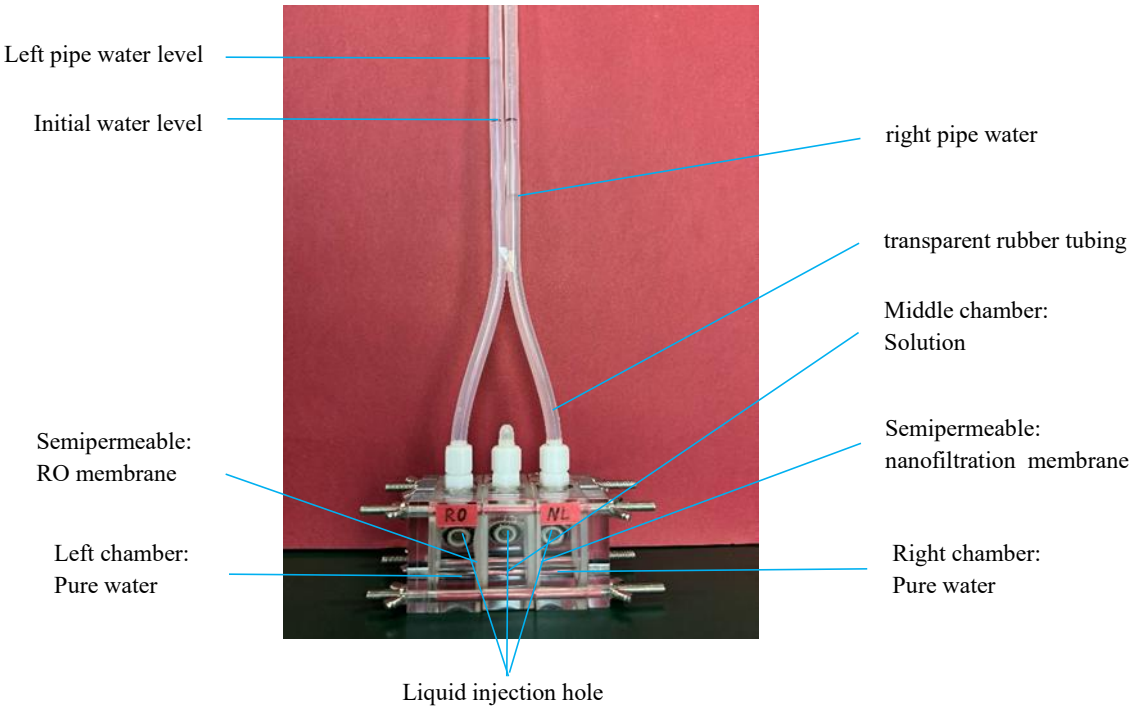

Fig.1 Experiment apparatus of the water level difference experiment using the charge-type electrostatic field method

Experimental Description: During the experiment, the middle compartment is filled with the solution and sealed at the top. Pure water is injected into both the left and the right compartments, each connected to an open transparent rubber tubing at the top,water can flow inside a pipe, and the initial water levels are equal. After liquid injection， osmosis occurs, and pure water entering the middle compartment from both sides, causing a slight drop in water levels in both tubes. Since the left RO membrane is non-charged, resulting in a normal concentration at the interface and correspondingly normal osmotic pressure. Consequently, the middle compartment quickly reaches osmotic pressure on the left side. Because the right nanofiltration membrane is charged, electrostatic attraction leads to a higher ion concentration and thus a higher osmotic pressure at its interface. As a result, water continues to enter the middle compartment from the right side, exerting reverse osmosis against the left membrane, causing the water level in the right tube to further decrease while the water level in the left tube begins to rise.The water levels on both sides are no longer the same, and a water level difference occurs. Consequently, osmosis and reverse osmosis continue until the right-side nanofiltration membrane reaches osmotic equilibrium when pure water no longer infiltrates and the water level in the right tube stops dropping. Similarly, the left-side RO membrane reaches reverse osmosis equilibrium when pure water no longer seeps out, and the water level in the left pipe stops rising. Finally, the water level of the system reaches equilibrium, and a significant water level difference appears between the left and the right water pipes.

2.Experiment apparatus of the electrostatic field method for water lifting experiment As shown in Figure2.

The main part of the experimental apparatus: It is the enlarged version of the aforementioned device,A 118mL multi-port microbial reactor is mainly composed of acrylic blocks with screw holes at the four corners, with three hollow blocks in the middle, and two solid blocks at both the left and the right side. A screw rod is used to pass through the screw hole to string together five acrylic blocks to form a hollow cavity.Two semipermeable membranes divide the hollow cavity into three compartments.Compared to the previous device, the main change is that the water inlet has been moved to the bottom.

Semipermeable membranes: FFM Technology (Beijing) Co., Ltd. The left side of the device is the RO membrane and the right side is a nanofiltration membrane,all are 56mm diameter round pieces. The model of RO membrane is FFM-FR, with a retention molecular weight of 100 daltons and uncharged. The model of nanofiltration membrane is FFM-NL, with a retention molecular weight of 200-300 daltons and negatively charged.

Transparent rubber tubing: with a 5mm inner diameter.

Solvents: Purified drinking water on the market.

Solute:Na_2SO_4. Tianjin Zhiyuan Chemical Reagent Co., GB/T9853-2008， Analytical grade.

Solution: self-prepared solution, with a concentration of 0.5% .

Dropper tip: 0.3mm medical injection needle

Water tank: Acrylic transparent water tank

Concentration meter: Xiaomi TDS detection pen, model XMTDS01YM.

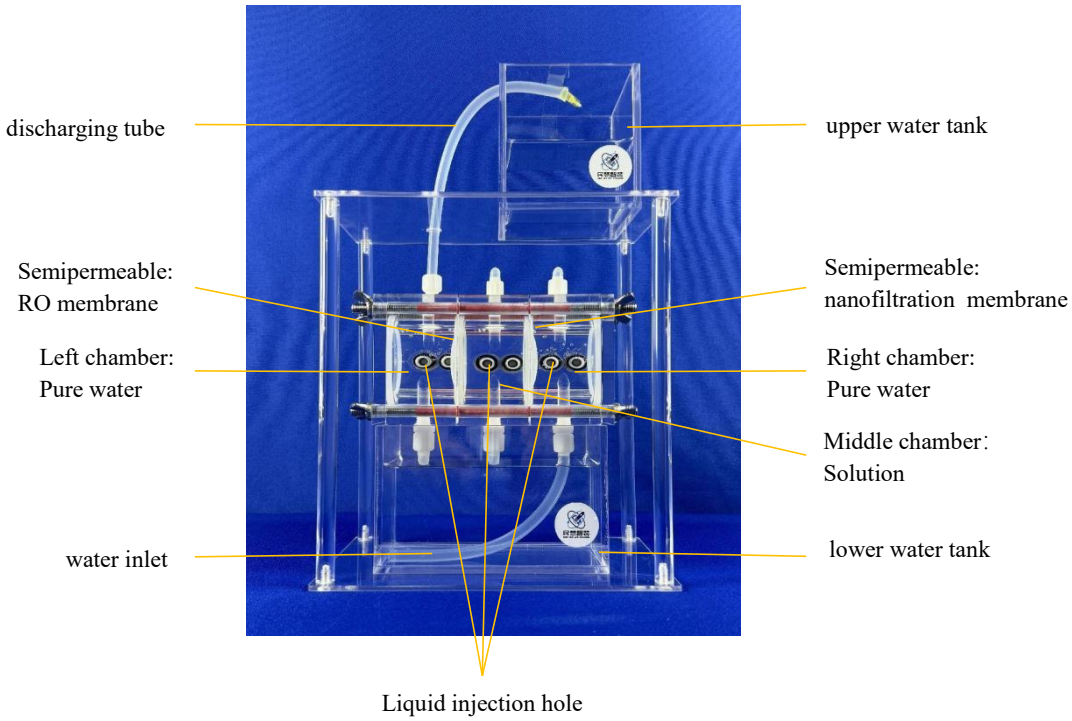

Fig.2 Experiment apparatus of the electrostatic field method for water lifting experiment

Experiment instructions:the middle compartment is filled with the solution and sealed at the top.Pure water is injected into both the left and the right compartments.The upper end of the left chamber is connected to a transparent rubber hose, which is open, water can flow inside a pipe into the upper water tank.The lower end of the right chamber is connected to a transparent rubber hose, which is filled with water and placed in a sink, allowing water to flow through the tube.The mechanism of osmosis and reverse osmosis is consistent with the above.Due to osmosis, water from the right chamber continuously enters the middle chamber, and the lower rubber tube constantly sucks up water from the lower water tank to replenish it.Due to reverse osmosis, the water in the middle chamber continuously flows into the left chamber and enters the upper water tank through the rubber tube at the top of the left chamber. This achieves the water-lifting from the lower water tank to the upper water tank.