

FLOW THROUGH WATER BRIDGE

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1. WATER BRIDGE

In 2007, Fuchs reported interesting phenomena that when high voltage is applied to deionized water filled in two contacted beakers, a floating water bridge forms spontaneously [1].

On Christmas Eve 2007, the TV program “Dream Vision” of Nihon TV (Japan) based on scientific interest was televised. In the special program, we introduced “water bridge” [2]. In the presentation, I will show you a shortened 3 minutes TV program.

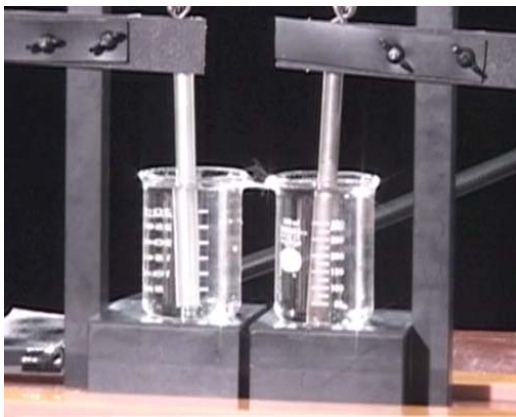


Fig.1 Apparatus



Fig.2 Water bridge

As shown in Fig.1, the tops of two beakers filled with deionized water being in contact each other, they were setting apart gradually under high voltage. Then a spanned bridge of water was observed between top of two beakers as shown in Fig.2. There are some theories to water bridge [3]. We assume that the phenomenon is caused by electrical dipole moment of H₂O molecules. High voltage arranges water molecules in a line of positive and negative polarity by turns like a rope. One cm long water bridge bundles many water ropes which are composed of arranged more than hundreds of millions of water molecules. Once a rope decays, a part of water bridge falls down. However it comes back again like polarity pulls back a rope. It is a surprising view. After several decays, finally produced heat as seen as steam in the figure breaks a rope and finished spanning the bridge. Streamer was also observed between two beakers after water bridge finished spanning.

Effect of voltage on maximum length of the bridge is shown in Fig.3. Not only voltage but also current affect maximum length of water bridge because current disturbs the alignment of H₂O molecules and it produces Joule heat.

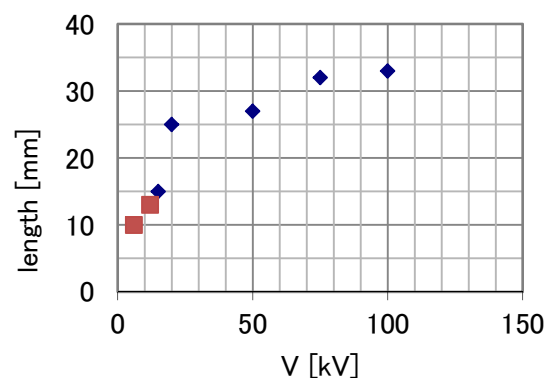


Fig.3 Effect of voltage on maximum length of water bridge. ■ : our result, ◇ : Nisshin electric co.

2. EFFECT OF ELECTROLYTE ON WATER BRIDGE LENGTH [4]

Water flows from a beaker to the other under the gradient of electricity. We have observed a twisted

flow, however Fig.2 seems to be smooth and straight. To know the direction of flow, a small quantity of NaCl was added to deionized water of a cathode side beaker. After voltage increased to 10 kV under the condition of 1 mm apart, electrical conductivity was measured in an anode side beaker. But we could not find any change. It means no flow from cathode to anode direction. On the other hand, when NaCl in an anode side beaker, electrical conductivity of cathode side increased as shown in Fig. 4. It revealed that water moved from anode to cathode direction.

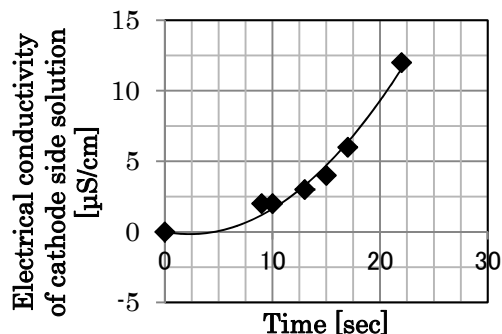


Fig.4 Change of electrical conductivity of cathode side. 10 kV under the condition of 1 mm apart between top of beakers

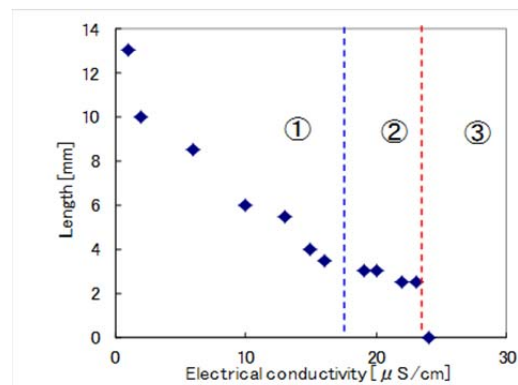


Fig.5 Effect of NaCl addition on maximum length of water bridge. 1:water bridge observation is easy. 2:streamer appears soon 3:no observation of water bridge. only streamer

Increasing NaCl addition brings decrease in maximum length of water bridge as shown in Fig. 5. Over 18 $\mu\text{S/cm}$, it is very hard to keep water bridge for a long time.

Of course, addition of an electrolyte disturbs formation of water bridge. Fig.6 compares the effect of three kinds of electrolytes on length of water bridge. It shows that dissociation ratio governs the length of water bridge. Perfect dissociation salts, i.e. NaOH and NaCl, gives the same disturbance effect and greater effect than NH_4Cl solution.

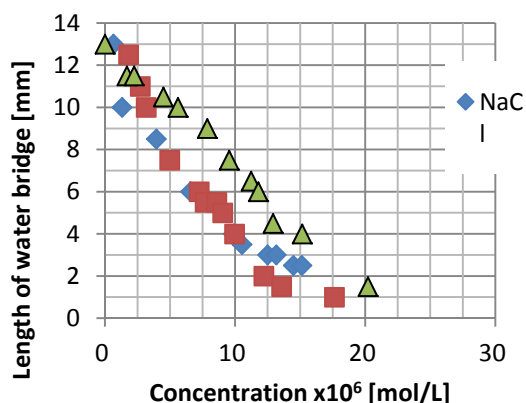


Fig.6 Effect of electrolytes on length of water bridge

CONCLUSION

Assuming that the phenomenon is caused by electrical dipole moment of H_2O molecules, we obtained the following conclusion.

1. Water bridge flows from anode to cathode direction.
2. To get a longer water bridge, disturbance alignment factor should be reduced, i.e. application of high voltage, as low as possible electrical conductivity solution, reduction of current with high electrical resistance.

REFERENCES

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