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The Marangoni Effect and Its Artistic Application

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Abstract. The Marangoni Effect is a phenomenon whereby movement of a liquid occurs due to local difference in the surface tension of the liquid. Although commonly occuring in nature on the ground, very careful observation is required to reveal this phenomenon due to the overtwhelming effects of gravity.

With the advancement of space experimentation under microgravity conditions, the Marangoni effect has attracted much attention. There was an expectation that heat convection in molten liquids would disappear completely under microgravity conditions, and that high quality crystals could thus be obtained as a consequence. However, it has since been found that under microgravity conditions the convection resulting from the Marangoni effect caused by the difference in the surface tension due to local temperature differences has the main problem (contrary to terrestrial conditions), and it has been made clear that high quality large sized crystals cannot be obtained without suppression of the Marangoni convection.

On the other hand, the Marangoni Effect has been utilized extensively in art works of dyeing on the ground. In this field the dyeing technique used is to float the dye or pigment on the surface of the basic medium (water or some other viscosity liquid) and then cover the surface with paper or cloth to take a print. Examples of this art form from throughout the world include “Suminagashi or Chinese ink marbling” in Japan and “Marble paper” in Europe, and similar art forms also exist in Turky and China. All of these art forms utilize the Marangoni Effect whereby movement of the dye towards the diffusion direction, and there are no examples which utilize movement of the dye toward the compression direction.

While involved in research on space experimentation in 1986, the author found that it was possible to utilize the Marangoni Effect to obtain dye patterns formed by movement of the dye towards both the expansion and compression directions, which has not been noticed in the past.

The dye or pigment is floated in thin film state on the surface of the water, and an artistic color pattern is formed utilizing the Marangoni Effect. The water surface is then covered with traditional Japapnese paper (Washi) at the time when the desired pattern has been obtained.

Also, it should be mentioned that it is very easy to obtain not only order patterns but also chaos patterns by using new method with suitable selection of dye or pigment used.

Besides being used simply as a new art technique, it can be supported that this technique can also put to practical use in the field of science education as an effective means for demonstrating one of the phenomenon of space experimentation, as the Marangoni Effect can be displayed in the classroom.