

These years, “phase” is one of the hot keywords in the research field of heat transfer and fluid flows, for example multiphase flow and phase change. There are many phases and patterns all around us also. They are called “SOH” in Japanese. Lines of the palm (TE-SOH), facial features (NIN-SOH), physiognomy (KOTSU-SOH) and one’s sleeping posture? (NE-ZOH), are related to our body. It is interesting that these SOHs except NE-ZOH are used to tell fortune. It must be fun if we also had NE-ZOH fortunetelling, though.

SOH is used for divination not just related to the body, but also: related to one’s house designs (KA-SOH), one’s estate (CHI-SOH), finger patterns of Buddha (IN-SOH), society (SE-SOH) and so on. All of them are important matters and also seem to be objects of fortunetelling. The Chinese character for “SOH,” which has a form of an eye looking at a tree, originally stands for investigation with careful observation. All the SOHs above symbolize shapes or appearances of the matters.

The lines of the palm, for example, the life line, intelligence line, feeling line, fortune line and so on, and the plumpness of the palm are classified into patterns to read one’s character, talent, capacity, physical condition, fortune and so on. Possibly we can define this method as a scientific way to predict one’s action based on the appearance, which reflects one’s use of their palm muscles.

IN-SOH is the finger pattern of Buddha statues. Each IN-SOH symbolically represents the Buddha’s expertise

and/or message. It may be a root of sign language for communication. The big Buddha in Nara raises right hand with turning his palm forward and lower left hand. This finger pattern means a message “Feel easy. I will give you anything you want.”

We also encounter many phases and patterns in the field of science and engineering. The technical term “phase” seems to be preferably employed for SOH in these fields. It is easy to show some examples of “phase,” such as ferrite phase or martensite phase of steel, three-phase alternating current of electricity, phase of plants in an island, color phase and so on. We learn “the three phases of substances, solid, liquid and gas,” in the fourth grade of elementary school. Let us talk briefly about these three-phases below.

Multi-phase flow is hot subject in the research field of heat transfer and fluid flows. It deals with the flows and the heat transfer phenomena of a mixture of solid-phase, liquid-phase and/or gas-phase. The mixture of solid particles with gas or liquid is called solid-gas two-phase flow or solid-liquid two-phase flow. We have talked about this kind of flow in my previous essay “The Work of Solid Particles.” Solid-liquid two-phase flows play very important roles in many industrial facilities. For example, fluidized beds for waste incinerators in which waste material, hot sand and air are mixed to burn. Pneumatic conveyers supply fine particles of coal for boilers in power plants. It is very important to design and operate these facilities carefully to avoid particle erosion problems.

# Patterns All around Us

Corporate Research & Development

**UCHIDA Hiroyuki**



A finger pattern of Buddha



A trick of the sound "Tok-Tok"

We also have talked about a liquid-gas two-phase flow in the essay "Where Does the Sound "Tok-Tok" Come from?" Such sound can be heard when pouring liquid from a bottle. It is generated by the flow of liquid and gas bubbles passing each other. This is one of typical gas-liquid two-phase flow, which is similar to an important flow phenomenon called "flooding" in the emergency core cooling system of nuclear power plants.

Spray or atomization flow, which consists of very fine liquid particles, is employed for the liquid fuel in combustors of the jet engines or rocket engines. Because it is essential to make uniform fine liquid particles in order to achieve high performance of the engines, it is very important to learn the behavior of the liquid particles when they are forming. Gas-liquid two-phase flows can be seen in our daily life also; bubble flow of the Jacuzzi® or the liquid particles flow of a shower. The three-phase flow, which consists of solid, gas and liquid phase, is often applied in the industrial facilities like air-lift pumps. Its working principle is simple: when air is introduced into bottom of a vertical pipe filled with water, water flows upward entrained by the bubbles moving up. If the water holds some solid particle suspension, they are pumped up with the water. As a typical application of air-lift pumps, pumping up of sea-mud containing rare earth elements is being researched. Air-lift pumps are also employed to clean-up the lake bed or unloading the fish from ships. Since centrifugal pumps have blades, they damage the fish. In contrast, air-lift pumps are able to transport them without damage. There are surprisingly many multi-phase flows around us.

Another subject is phase-change. Water changes its appearance with temperature; solid-phase ice melts into liquid-phase water, and then evaporates into gas-phase vapor. Even when its phase changes its molecular symbol  $H_2O$  does not change. We may have seen vapor from mouth of the pot. Boiled water spouts as vapor, changing phase, and then the vapor is cooled by surrounding atmosphere into liquid particles again, changing phase again, to be observed as

white steam. The vapor near the mouth is really transparent and invisible. This is the gas-phase water. The visible white steam is just a crowd of fine liquid water particles. In the large boiler of the power plant, heated water boils to vapor bubbles and they are mixed with liquid water. When heating is severe, the surface of heat transfer tube is covered by vapor. It causes over-heating, or dry-out, and the generation of vapor becomes insufficient. Because energy supply is an increasingly important issue in the world, better ways of boiling are paid attention again.

Phase change also play a wonderful role in nature, where we enjoy various impressive scenes. In the cold morning, sometimes we encounter the fog and the glazed frost on the river. The vapor generated from a relatively warm water surface is cooled by the cold atmosphere and changes into fine water particles, which is observed as steam or fog. When the water particles are deposited on the branches of the trees as ice, or vapor in the air directly sublimates to generate ice, very fantastic and beautiful glazed frost sometimes appear.

As talked about above, "SOH" are used to classify various shapes and patterns all around us. In the future, there may be old-fashioned discussions as follows: "This car has a long-lived Car-SOH." by using a new evaluation index Car-SOH, or "This bridge has a happy Bridge-SOH." We may have new viewpoints when we look around us paying attention to "SOH."

(Photos : Hiroyuki Uchida)

By the way, do you notice that the background image of this page is SOH itself?

(Chinese letter SOH can also be read as MOKUME i.e. wooden board texture)



Glazed frost

