	Scrubber system A scrubber system is used when handling acids. It prevents corrosion of ducts, etc. by dissolving vaporized acid in water that is showered from a scrubber. When discharging water from a scrubber, check pH using a pH test strip, etc. Water can be discharged if pH is between 5.5 and 8.5 (on-campus standard). If pH exceeds the standard value, neutralize the water so that pH is within the standard value before discharging.

* Note: When using “specified chemical substances” and “organic solvents” as defined in the Industrial Safety and Health Act, make sure to use such substances while operating local exhaust ventilation. These substances must not be used when local exhaust ventilation is not in place. If you wish to use these substances, consult with the Safety and Health Management Team of the Facilities Management Division.

When using other organic solvents and volatile chemical substances without local exhaust ventilation, ensure sufficient ventilation during use (e.g., open a window, install a ventilation fan).

3. Handling of apparatuses

When handling chemical substances, apparatuses made from various materials are used. However, the use of apparatuses made from inappropriate materials can lead to a major accident. When selecting apparatuses, consider the characteristics of chemical substances and the characteristics of materials from which apparatuses are made. This section explains the main materials used for apparatuses.

(1) Glass apparatuses

Glass apparatuses melt when exposed to hydrofluoric acid. They are also eroded gradually by strong alkali chemical substances but are highly resistant to chemical substances. They are most frequently used in chemistry experiments. However, they are easily breakable. Glass fragments are sharp and often cause deep cuts. It is necessary to take utmost care when handling them. When using glass apparatuses, take the following precautions in particular.

[1] Check for scratches before use. Do not use scratched ones.
[2] Do not hold thin parts (e.g., openings) and weak parts (e.g., joints) of glass apparatuses with a single hand.
[3] Do not impact glass apparatuses.
[4] When assembling a system, do not apply excessive force. Use clips, clamps, etc. to prevent them from falling, etc.
[5] Avoid rapid heating or cooling.
[6] When inserting a glass tube, thermometer, etc. into a rubber tube, rubber plug, etc., wet the glass with water or alcohol and insert the glass tube, thermometer, etc. gently and gradually while rotating it. Hold glass about 2 to 3 cm from the insertion area. Glass is likely to break when a part further away is held. The same applies to the removal procedure. Do not apply excessive force.
[7] If the edge of a glass apparatus is sharp, burn and round the part using a burner, etc. It takes time to cool. There are risks of burns even if the glass appears to have been cooled. Take

precautions.

[Examples of accidents]

- An experimenter was inserting a thermometer into a silicon rubber plug while holding the edge of a thermometer. The thermometer broke and stuck the hand in which the rubber plug was held, resulting in severe bleeding and a wound.
- An experimenter was inserting the arm of a side arm flask into a Liebig condenser while holding the main part of the flask. The arm parts broke, resulting in severe bleeding from three fingers of the right hand and wounds.

[Handling of glass apparatuses equipped with a ground glass joint]

Glass apparatuses used for experiments that require sealing are equipped with a ground glass joint.

Regarding interchangeable ground glass joints, the size is specified by JIS, and these joints are compatible. The use of similar apparatuses (which are not glass apparatuses equipped with a ground glass joint) may cause problems, such as leakage. Take the following precautions when using these apparatuses.

[1] Remove all the ground glass joints from the main part. Clean them to remove chemicals adhering to the surface.
[2] Strong alkali chemical substances may cause ground glass joints to be fused. Avoid using strong alkali chemical substances as much as possible.
[3] Ground glass joints cannot be removed if they are left in close contact for a long period. For storage, keep the joints separate or insert a piece of medical paper, etc.
[4] Regarding the glass cock of a separatory funnel, burette, etc., the use of a cock of a different apparatus may result in leakage. Tie the cock with the main part using a string to avoid mixing.
[5] Apply grease to the ground glass joints as necessary. Take precautions against contamination by grease.

(2) Stainless steel apparatuses

Stainless steel is widely used in chemistry experiments. They are used for reaction containers, beakers, medicine spoons, microspatulas as well as supports and clamps for devices, etc. The material is resistant to rust, robust, and very convenient but is corroded by acids and alkalis. It is hardly corroded by organic solvents. Take the following precautions when using stainless steel.

[1] Do not use stainless steel for containers for acid or alkali solutions and agitators.
[2] Stainless steel is resistant to impact, etc. due to ductility but is subject to erosion due to friction between metals, etc. Take precautions against contamination.
[3] Potassium permanganate and other organic peroxides react violently with metal powders, and this may cause an explosion. Do not use stainless steel materials. Check the characteristics of chemical substances. Use stainless steel for chemical substances that do not cause problems.

(3) Plastic apparatuses

Plastic apparatuses are so inexpensive and handy that they are also used as disposable apparatuses, but they are susceptible to heat. The chemical resistance varies depending on the material. Take the following precautions.

[1] Do not apply heat basically. When applying heat, check the heatproof temperature of the material. Plastic apparatuses melt and cannot be removed.
[2] Keep plastic apparatuses away from fire, and do not place such apparatuses near fire. Otherwise, plastic apparatuses burn.
[3] Make sure to check the chemical resistance of the materials depending on the chemical substances to be used. Failure to do so may cause containers and medicine spoons, etc. to melt during use. The properties of commonly used plastics are as follows.
Examples) ABS resin: It is melted by organic solvents such as acetone and toluene. It softens at about 70°C.
Polyethylene: It is relatively resistant to organic solvents and is often used to store chemical substances. It softens below 100°C.

Polypropylene: It is relatively resistant to organic solvents and is used to store chemical substances. It can withstand up to about 140°C.

[Examples of accidents]

- Water was poured into a plastic beaker made from polypropylene. It was directly placed on a hot stirrer to heat the water. The plastic beaker melted, adhered to the plate, and burned, causing the water in the beaker to flow out.

4. Toxicity and hazards of chemical substances

General toxicity and hazards of chemical substances are as follows. Take precautions.

[1] Explosion and fire
Chemical hazards include explosivity, combustibility, flammability, combustion-supporting properties, self-reactivity, spontaneous combustibility, self-heating properties, water reactivity and combustibility, and oxidizability. Physical hazards include destruction of containers due to abrupt reaction and decomposition.

[2] Health impairment
Chemical substances have physiological toxicity and are acutely or chronically toxic to the human body and biosystem, including metal corrosivity, acute toxicity, skin corrosivity and irritation, eye damage, eye irritation, respiratory sensitization, skin sensitization, productive cell mutagenicity, carcinogenicity, reproductive toxicity, and specific target organ and systemic toxicity. In some cases, significant effects of physiological toxicity were observed several years to several decades later.

[3] Environmental pollution
Chemical substances have environmental toxicity, including acute aquatic toxicity, chronic aquatic toxicity, and ozone depleting properties.