Japan Society for Analytical Chemistry and the 98th Meeting of the Association of Measurement of Mechanical Quantities of the Society of Instrument and Control Engineers (the 32nd, presentation material) Theme: Dispensing operation using a micropipette

Non-Patent Document 2: https://ocw.kyoto-u.ac.jp/ja/faculty-of-agriculture-jp/5129000/pdf/03.pdf

Non-Patent Document 3: https://www.aandd.co.jp/adhome/pdf/tech_doc/analytical/pipette_guide.pdf

SUMMARY

PROBLEMS TO BE SOLVED

[0006]

As described above, when handling a volatile liquid with a pipette or the like, the liquid is volatilized at the time of suction, whereby an air layer in the tip or the cylinder expands to increase the pressure, causing a phenomenon that the liquid is pushed out. This phenomenon is called liquid leak or liquid drip. This prevents accurate measurement of the liquid.

[0007]

As a method to reduce the influence of volatilization of the volatile liquid, saturating the air layer with volatilized

liquid molecules by repeatedly sucking and ejecting the liquid several times before measuring the volatile liquid is also proposed (see Non-Patent Documents 2 and 3). However, when such a method is adopted, although it has been possible to reduce the liquid leakage rate from the suction/ejection port, it has not been possible to completely eliminate the liquid leakage.

[0008]

Further, since the above method intentionally volatilizes the liquid to be measured to saturate the air layer in the cylinder, a problem is that the amount of liquid to be measured is reduced by evaporation. For example, if the liquid to be measured is present by an amount of 500 µL, even if about 2 µL volatilizes and the amount becomes 498 µL, the reduction amount is about 4%, and the influence is small. However, if only a small amount of the liquid to be measured is present, for example, 5 µL, if about 2 µL of 5 µL volatilizes to make 3 µL, the amount of liquid is reduced by about 40%, and the influence is very critical.

[0009]

Therefore, the above-mentioned method cannot be adopted when handling a very small amount such as only a few µL of volatile liquid.

[0010]

Thus, an object of the present disclosure is to suppress

liquid leakage from a pipette due to volatilization of volatile liquid.

SOLUTIONS TO THE PROBLEMS

[0011]

A processing method according to the present disclosure is a processing method for a volatile liquid using a pipette including a cylinder, a piston that slides in the cylinder, and a tip attached to a tip end of the cylinder, the tip including a suction/ejection port, the pipette performing suction and ejection of a liquid through the suction/ejection port of the tip in accordance with movement of the piston. The processing method includes the following steps:

a low-volatility liquid suction step of sucking a low-volatility liquid that is less volatile than the volatile liquid through the suction/ejection port;

an air suction step of sucking air through the suction/ejection port after the low-volatility liquid suction step; and

a volatile liquid suction step of sucking the volatile liquid through the suction/ejection port after the air suction step.

[0011a]

In an aspect, there is provided a processing method for a liquid to be sucked using a pipette including a cylinder,

a piston that slides in the cylinder, and a tip attached to a tip end of the cylinder, the tip including a suction/ejection port, the pipette performing suction and ejection of a liquid through the suction/ejection port of the tip in accordance with movement of the piston, the processing method comprising a liquid suction step of sucking the liquid to be sucked through the suction/ejection port,

the processing method comprising, before the liquid suction step, if the liquid to be sucked is a volatile liquid:

a low-volatility liquid suction step of sucking a low-volatility liquid that is less volatile than the liquid to be sucked through the suction/ejection port; and

an air suction step of sucking air through the suction/ejection port after the low-volatility liquid suction step.

[0012]

A liquid processing apparatus according to the present disclosure is an apparatus configured to perform the processing

[0012a]

In another aspect, there is provided a liquid processing apparatus comprising:

a pipette including a vertically positioned cylinder, a piston that slides in a vertical direction in the cylinder, and a tip, the tip being attached to a lower end of the cylinder in such a way that an suction/ejection port provided at a tip end of the tip faces downward, the pipette performing suction and ejection of a liquid through the suction/ejection port of the tip in accordance with movement of the piston;

a driving mechanism that causes the pipette to operate;

a liquid container accommodating a liquid to be sucked;

a low-volatility liquid container accommodating a low-volatility liquid; and

a control part that controls the driving mechanism,

wherein the control part is configured to control the driving mechanism in such a way that, if the liquid to be sucked is a volatile liquid, a low-volatility liquid suction operation of sucking a preset amount of the low-volatility liquid from the low-volatility liquid container, and an air suction operation of sucking a preset amount of air through the suction/ejection port after the low-volatility liquid suction operation are performed before a liquid suction operation of sucking a predetermined amount of the liquid to be sucked from the liquid container is performed.

[0013]

The low-volatility liquid in the present disclosure is a substance that has a boiling point of 95°C or higher and is in a liquid state at normal temperature (20°C ± 15°C). Examples of such a low-volatility liquid include, for example, water, dimethylsulfoxide, glycerol, phenol, and toluene.

[0014]

The volatile liquid in the present disclosure is a substance that has a boiling point in the range of 50 to 95°C and is in a liquid state at normal temperature (20°C. ± 15°C), or a liquid that contains 10% or more of such substance. Examples of the substance that has a boiling point in the range of 50 to 95°C and is in a liquid state at normal temperature (20°C. ± 15°C) include acetonitrile, methanol, ethanol, acetone, toluene, isopropanol, hexane, butanol, cyclohexane, ethylene glycol, benzene, chloroform, acetaldehyde, triethylamine, phenol, naphthalene, formaldehyde, tetrahydrofuran, and ethyl acetate.

EFFECTS

[0015]

In the processing method for volatile liquid according to the present disclosure, since a volatile liquid is sucked after sucking a low-volatility liquid less volatile than the volatile liquid and air (hereinafter referred to as pre-suction), the volume of an air layer above the volatile

liquid sucked into a pipette is smaller than in the case where the pre-suction is not performed. As a result, the volume expansion of the air layer expanding due to the volatilization of the volatile liquid is reduced, so that liquid leakage of the volatile liquid from the pipette is less likely to occur and thus, the measurement accuracy of the volatile liquid increases as compared with the case where the pre-suction is not performed.

[0016]

In the liquid processing apparatus according to the present disclosure, since the Control part that controls the driving mechanism that drives the pipette is configured to perform suction of the volatile liquid after performing the above-described pre-suction in the process of sucking the volatile liquid by the pipette, liquid leakage of the volatile liquid from the pipette is less likely to occur, and the measurement accuracy of the volatile liquid is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a schematic configuration diagram illustrating an embodiment of a liquid processing apparatus.

Fig. 2 is a flowchart showing an example of a series of operations at the time of liquid suction according to the same embodiment.

CLAIMS

1. A processing method for a liquid to be sucked using a pipette including a cylinder, a piston that slides in the cylinder, and a tip attached to a tip end of the cylinder, the tip including a suction/ejection port, the pipette performing suction and ejection of a liquid through the suction/ejection port of the tip in accordance with movement of the piston, the processing method comprising a liquid suction step of sucking the liquid to be sucked through the suction/ejection port,

the processing method comprising, before the liquid suction step, if the liquid to be sucked is a volatile liquid:

a low-volatility liquid suction step of sucking a low-volatility liquid that is less volatile than the liquid to be sucked through the suction/ejection port; and

an air suction step of sucking air through the suction/ejection port after the low-volatility liquid suction step.

2. The processing method according to claim 1, wherein the amount of air sucked through the suction/ejection port in the air suction step is determined in accordance with the volatility of the liquid to be sucked and the sucking amount of the liquid to be sucked in the volatile liquid suction step.

3. The processing method according to claim 1 or 2, further comprising;

a checking step of checking whether the liquid to be sucked is a volatile liquid; and

a determining step of determining whether to perform the low-volatility liquid suction step and the air suction step.

4. The processing method according to any one of claims 1 to 3, wherein the low-volatility liquid is any one of water, dimethyl sulfoxide, glycerol, and phenol.

5. The processing method according to any one of claims 1 to 4, wherein the volatile liquid is any one of acetonitrile, methanol, ethanol, acetone, toluene, isopropanol, hexane, butanol, cyclohexane, ethylene glycol, benzene, chloroform, acetaldehyde, triethylamine, phenol, naphthalene, formaldehyde, tetrahydrofuran, and ethyl acetate, or a liquid containing 10% or more of these.

6. A liquid processing apparatus comprising:

a pipette including a vertically positioned cylinder, a piston that slides in a vertical direction in the cylinder, and a tip, the tip being attached to a lower end of the cylinder in such a way that an suction/ejection port provided at a tip end of the tip faces downward, the pipette performing suction

and ejection of a liquid through the suction/ejection port of the tip in accordance with movement of the piston;

a driving mechanism that causes the pipette to operate;

a liquid container accommodating a liquid to be sucked;

a low-volatility liquid container accommodating a low-volatility liquid; and

a control part that controls the driving mechanism,

wherein the control part is configured to control the driving mechanism in such a way that, if the liquid to be sucked is a volatile liquid, a low-volatility liquid suction operation of sucking a preset amount of the low-volatility liquid from the low-volatility liquid container, and an air suction operation of sucking a preset amount of air through the suction/ejection port after the low-volatility liquid suction operation are performed before a liquid suction operation of sucking a predetermined amount of the liquid to be sucked from the liquid container is performed.

7. The liquid processing apparatus according to claim 6, wherein the sucking amount of air of the air suction operation is determined in accordance with the volatility of the liquid to be sucked and the sucking amount of the liquid to be sucked of the volatile liquid suction operation.

8. The liquid processing apparatus according to claim 6 or

7, wherein the control part stores a list of volatile liquids, and is configured to determine whether the liquid to be sucked is a volatile liquid based on the list.

9. The liquid processing apparatus according to any one of claims 6 to 8, wherein the low-volatility liquid is any one of water, dimethyl sulfoxide, glycerol, and phenol.

10. The liquid processing apparatus according to any one of claims 6 to 10, wherein the volatile liquid is any one of acetonitrile, methanol, ethanol, acetone, toluene, isopropanol, hexane, butanol, cyclohexane, ethylene glycol, benzene, chloroform, acetaldehyde, triethylamine, phenol, naphthalene, formaldehyde, tetrahydrofuran, and ethyl acetate, or a liquid containing 10% or more of these.