A Study of Canister Humidification by Static Method

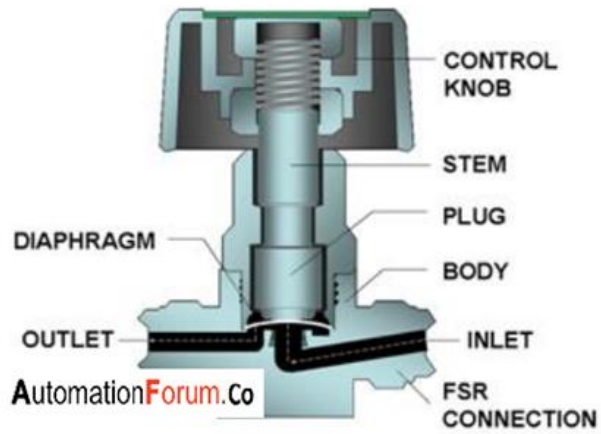## Present to NAAMC

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The Humidity in Canister May Not Stable That may be Due to Different Reasons

1, How to Add Water Into Canister

2, The Canister Internal Surface

3, The Canister Water Vapor Saturation

4, Other Possible Satuation (Tube Valve, Etc.)

Add Water to Canister

CONTROL KNOB
STEM
PLUG
DIAPHRAGM
BODY
OUTLET
INLET
AutomationForum.Co
FSR CONNECTION

H39

Canister A10680
2 Hours After
Water Injection

Add Water to Canister

Take Water into Syringe

Inject Water from Syringe to Canister Valve Surface or through Septa

Cap the Canister Valve or Wait 30 Sec If through Septa

Open the Canister Valve and Waiting 3 Hours for Water Balance

Add Water to Canister

How Water Get Into Canister?

Water Drop Vaporated and Water vapor go into Canister through Valve?

Water not Vaperated and the Water Drop go through the Valve and Flow Into Canister?

What IS The Homidity (RH%) in The Canister 24 Hours Later?

Add Water to Canister

Another Better Practice
By Some Lab (Restek)

Water is Vaporated in a
Container by Inert Gas
Bubbling Passing

The Humdification is
meassured and
Controlled

Introduce the Humidified
Inert Gas (N2 or Air)
Into Canister

$$Vw = Dsat \cdot RHd \cdot Vc \cdot Pc/Ps \cdot 1/Dw$$

where:

Vw = water volume to add to canister (µL)

Dsat = saturation vapor density of water (mg/µL) at ambient laboratory temperature (refer to Table 13-1)

RHd = desired RH level expressed as a decimal

Vc = nominal internal volume of canister (L)

Pc = final pressure of canister (kPa absolute)

Ps = standard ambient pressure (101.3 kPa absolute)

Dw = density of water (1 mg/µL)

Water Saturation Vapor Density at Various Tesperature

Water Saturation Vapor Density at Various Temperatures

Temperature (°C) Water Saturation Vapor Density (mg/L) (a)

15°C=12.8, 16°C= 13.6, 17°C= 14.4, 18°C= 15.3, 19°C= 16.3,

20°C= 17.3, 21°C=1 18.3, 22°C= 19.4, 23°C= 20.6, 24°C= 21.8, 25°C= 23.1

26°C= 24.4, 27°C= 25.9,   28 °C=27.3, 29°C= 28.9, 30°C= 30.5, 31°C= 32.2,

32°C= 34.0, 33°C= 35.8

(a) Values are generated according to the following formula (Nave, 2017):
$vapor\ density\ (mg/L)$ = 5.018 + 0.32321 $\cdot T$ + 8.1847 × $10^{-3}T$
2 + 3.1243 × $10^{-4}T3$
where: T = temperature in °C

An analyst prepares a VOC standard in a 6-L canister, diluting to a final pressure of 202.6 kPa (2 ata) with dry HCF zero air. The laboratory temperature is 25 °C and the analyst wants the standard to be 50% RH. The volume of water needed is calculated as follows:

VW = 23.1 mg/L · 0.50 · 6 L · 202.6/101.3/1 µL/mg = 139 µL

Example Calculation by TO-15A

If The Canister Final Pressure is 303.9kPa Still Want 50% RH,
VW = 23.1 mg/L · 0.50 · 6 L · 303.9/101.3/1 µL/mg = 209 µL
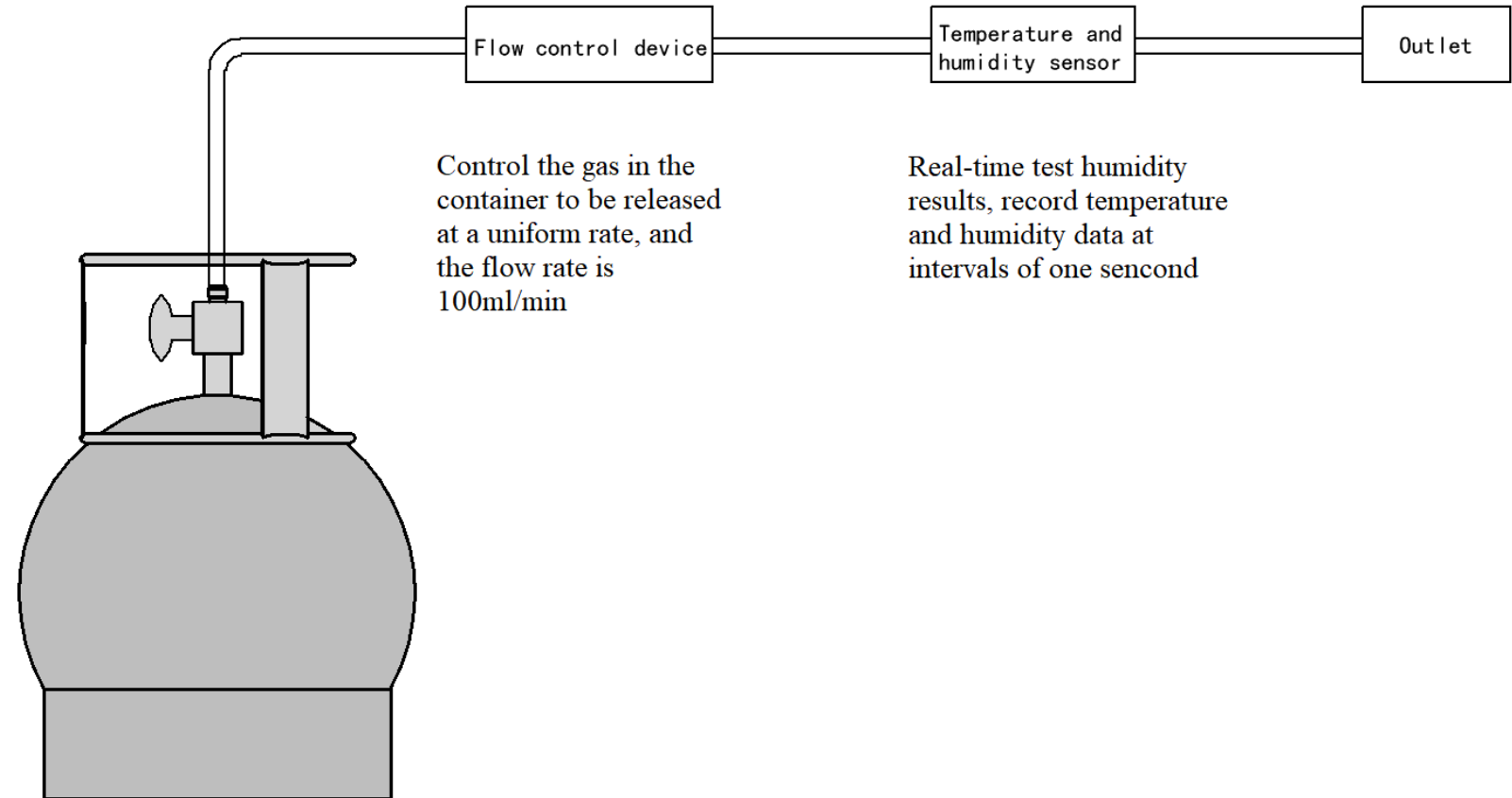Can We Add 209 uL Water to Make this 50% RH
The Answer is: No.
The Max Water uL Can be Added is 139uL (Saturate RH) for a 6 Liter Canister at 25°C No Mater the Final Pressure is What

1, Water Vapor Pressure is only depended by the temperature.

2, There is a max volume of water can be added with a fixed volume Canister .

3, Pressurize the canister to higher pressure does not allow to add more water to make the humidification higher

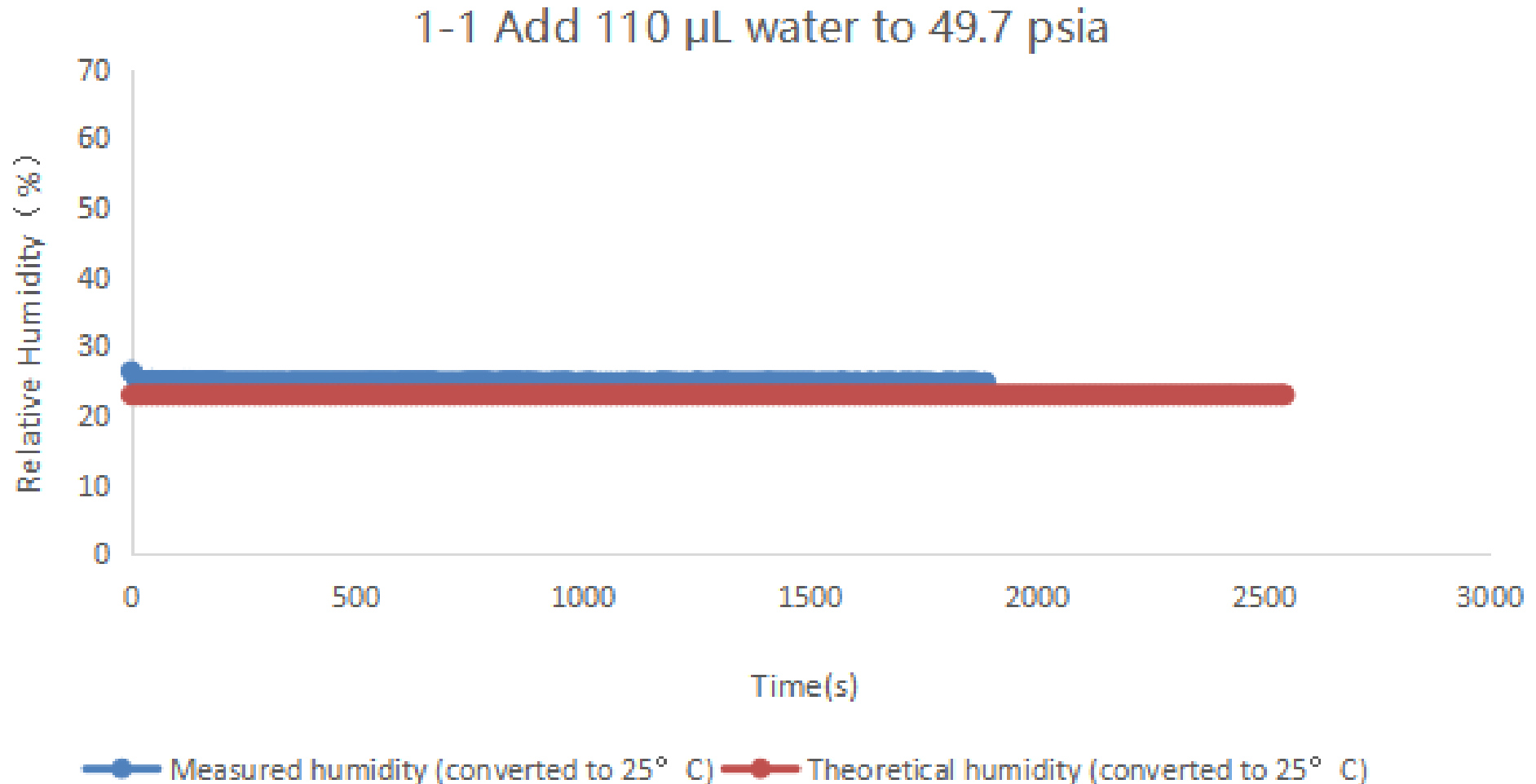4, The over added water into canister will be condensed.

Measurement Humidity in the Canister

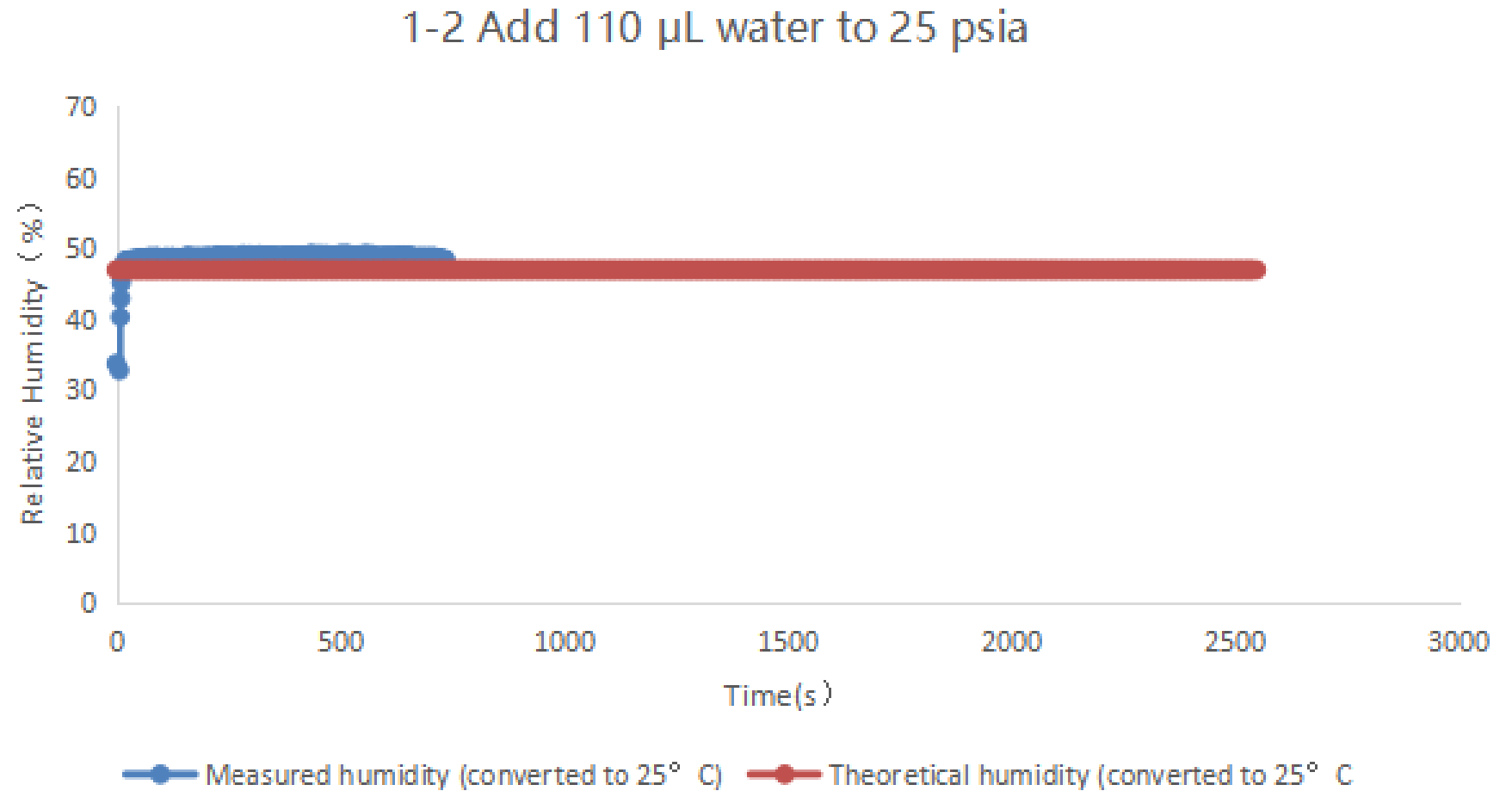| Flow control device	Temperature and humidity sensor	Outlet

Control the gas in the container to be released at a uniform rate, and the flow rate is 100ml/min

Real-time test humidity results, record temperature and humidity data at intervals of one sencond

110ul water Added, The The outlet Humidity is Stable and Match Calculation

1-1 Add 110 µL water to 49.7 psia

Relative Humidity（%）vs Time(s)

Measured humidity (converted to 25°C)　　Theoretical humidity (converted to 25°C)

110ul water Added, The The outlet Humidity is Stable and Match Calculation

1-2 Add 110 μL water to 25 psia

134ul water Added, The The outlet Humidity is Stable and Match Calculation with Little Unstable

2-1 Add 134 μL water to 45 psia
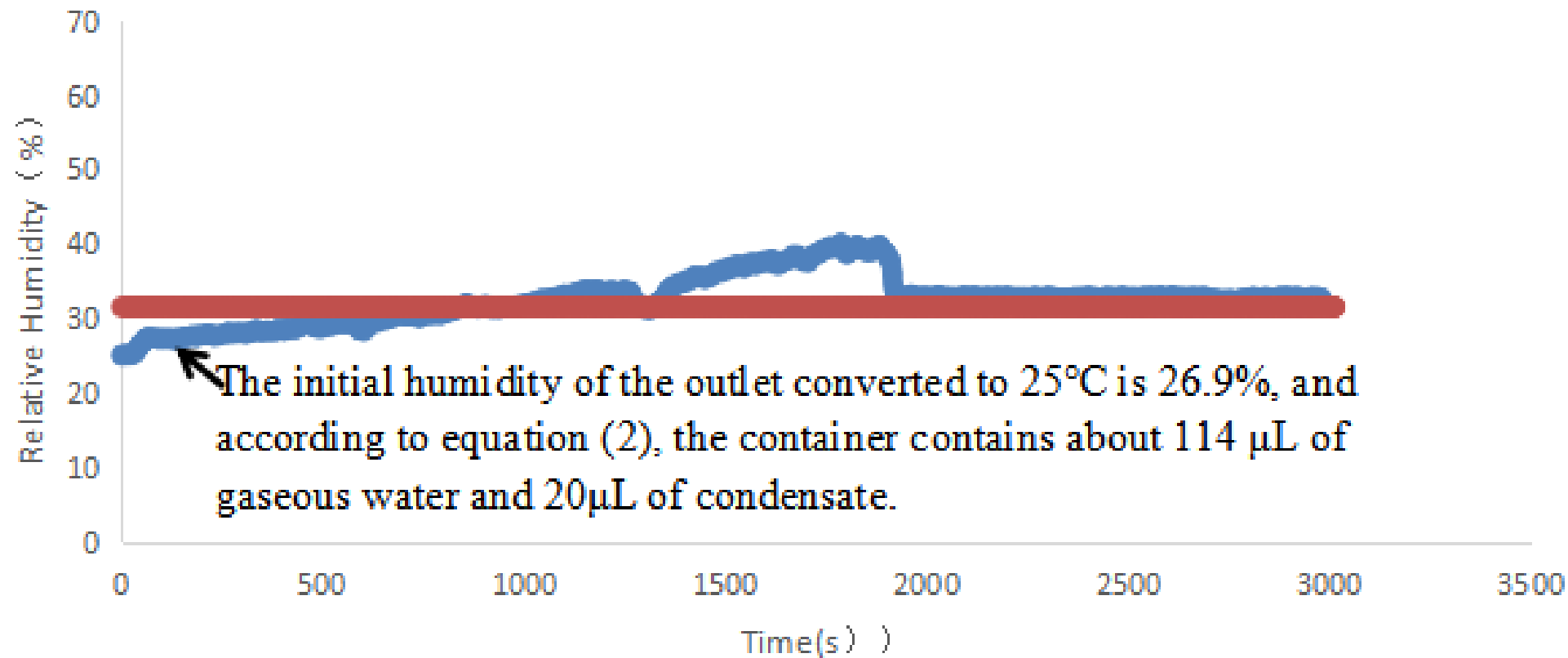
Relative Humidity（%）

Time(s））

The initial humidity of the outlet converted to 25°C is 26.9%, and according to equation (2), the container contains about 114 μL of gaseous water and 20μL of condensate.
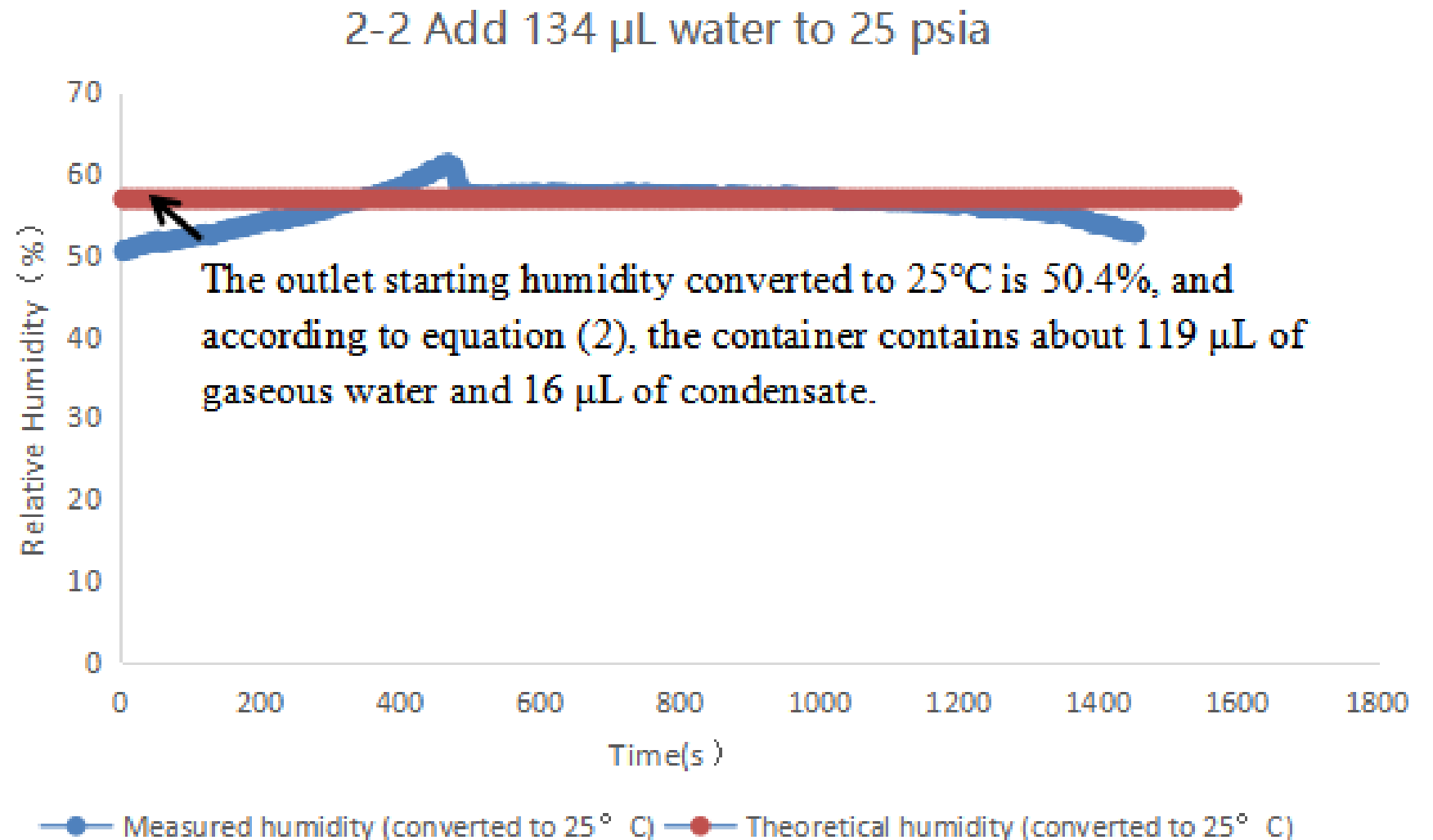
134ul water Added, The The outlet Humidity is Stable and Match Calculation with Little Unstable

2-2 Add 134 μL water to 25 psia

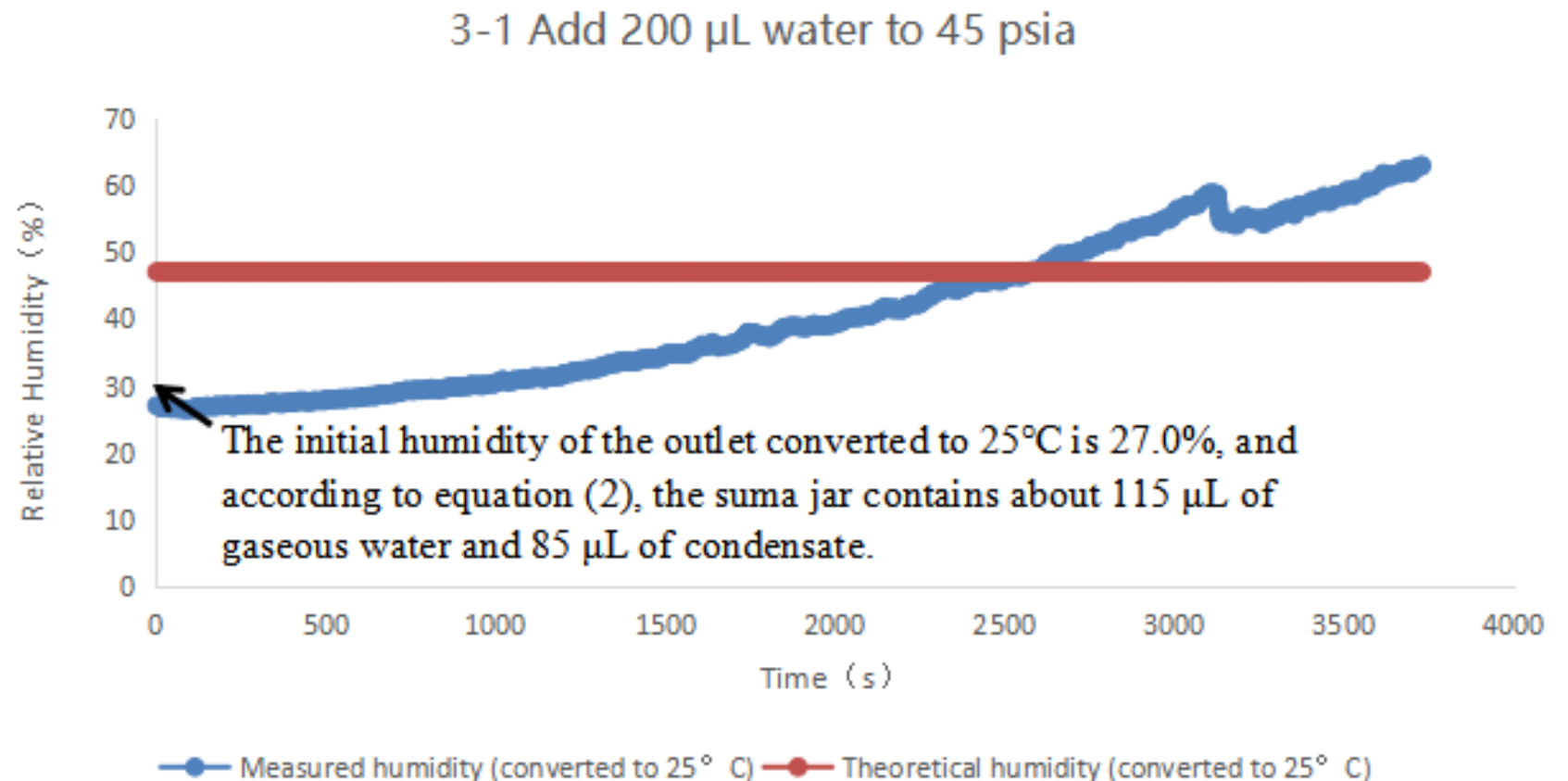The outlet starting humidity converted to 25°C is 50.4%, and according to equation (2), the container contains about 119 μL of gaseous water and 16 μL of condensate.

Relative Humidity（%）

Time(s）

Measured humidity (converted to 25°C) — Theoretical humidity (converted to 25°C)

200ul water Added, The The outlet Humidity is Not Stable Comparison With the Calculation

3-1 Add 200 μL water to 45 psia

The initial humidity of the outlet converted to 25°C is 27.0%, and according to equation (2), the suma jar contains about 115 μL of gaseous water and 85 μL of condensate.

Relative Humidity (%)

Time (s)

Measured humidity (converted to 25° C)　Theoretical humidity (converted to 25° C)
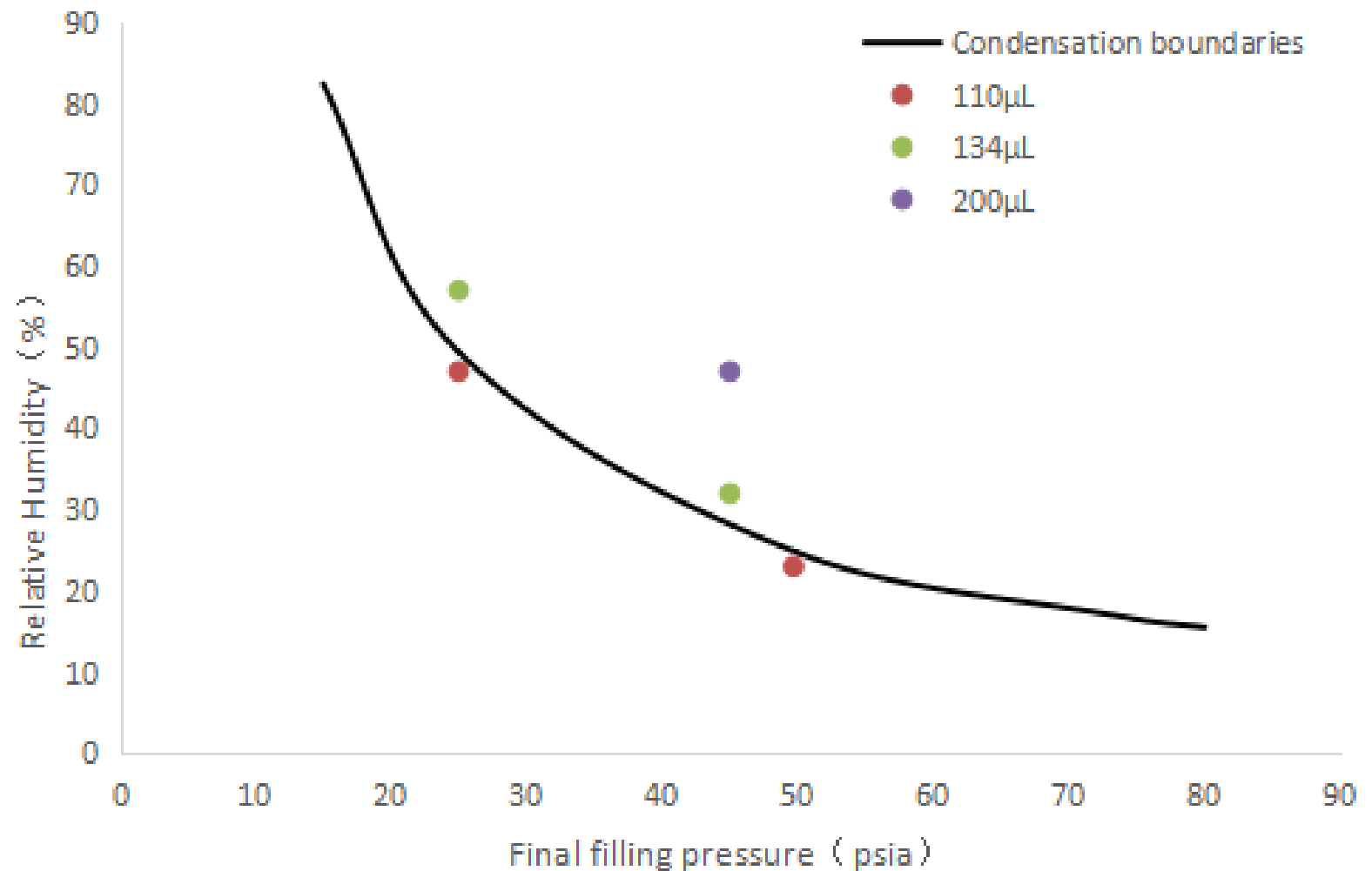
200ul water Added, The The outlet Humidity is Become Stable Once The Canister Temperature Increase

3-1 Add 200 µL water to 45 psia and heat the system

Relative Humidity (%)

时间（s）

Measured humidity (converted to 25°C)　　Theoretical humidity (converted to 25°C)
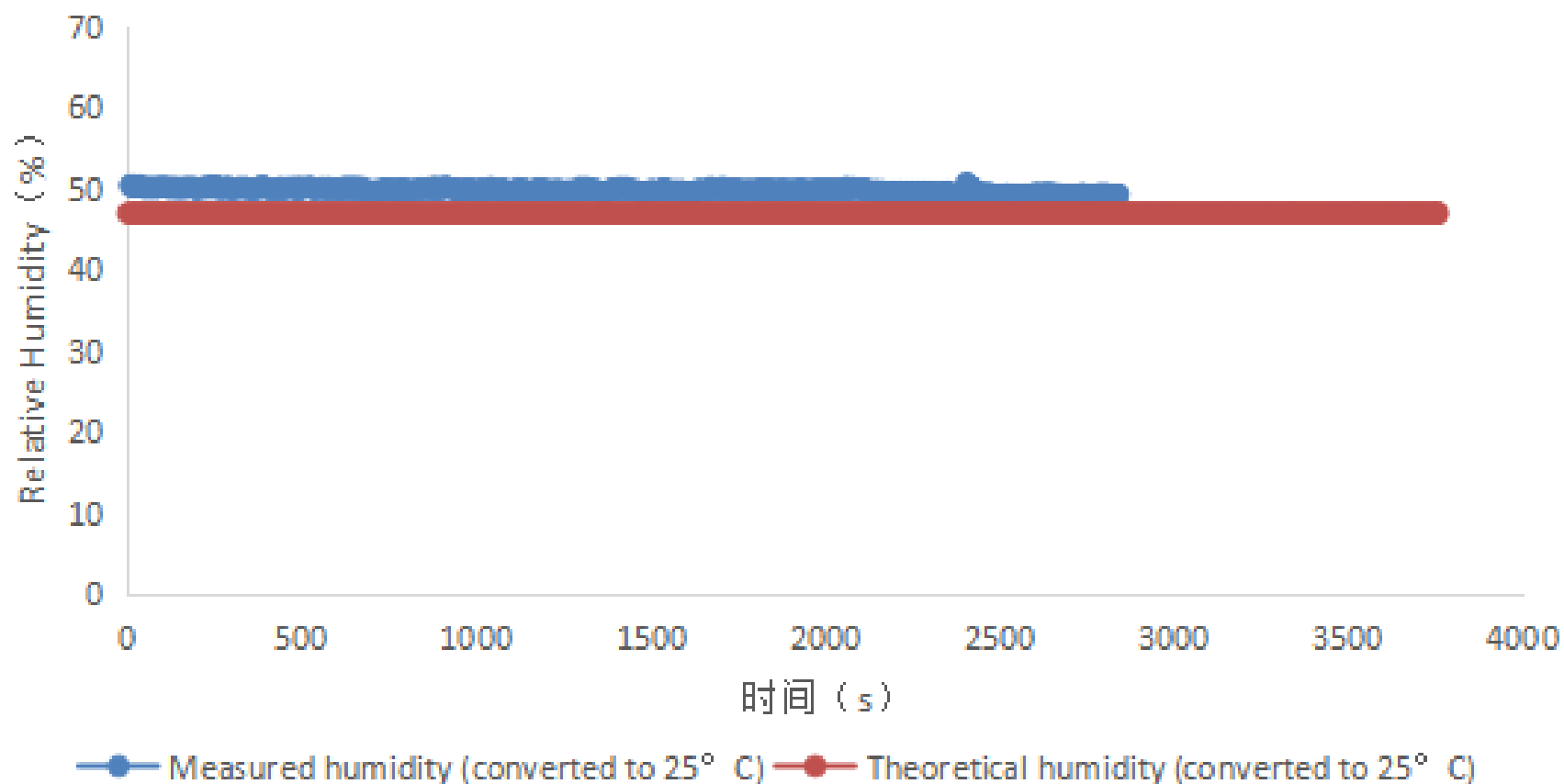
The Over Added Water Will Be Condensed

Water Condensed According To The Added Volume

(1) There is a maximum water fill limit for a certain volume of canister at a certain temperature. Increase the Canister Final Pressure can not Increase the Water Add Amount
(2) Excess water will be condensed in the canister, or Make the Outlet Steam Humidity Unstable
(3) To Obtain the High Humidity Standard or Simulating High Humidity samples Using the standard not pressurized to high pressure or headed to a slightly higher temperature

Thank you！

2024/8/13