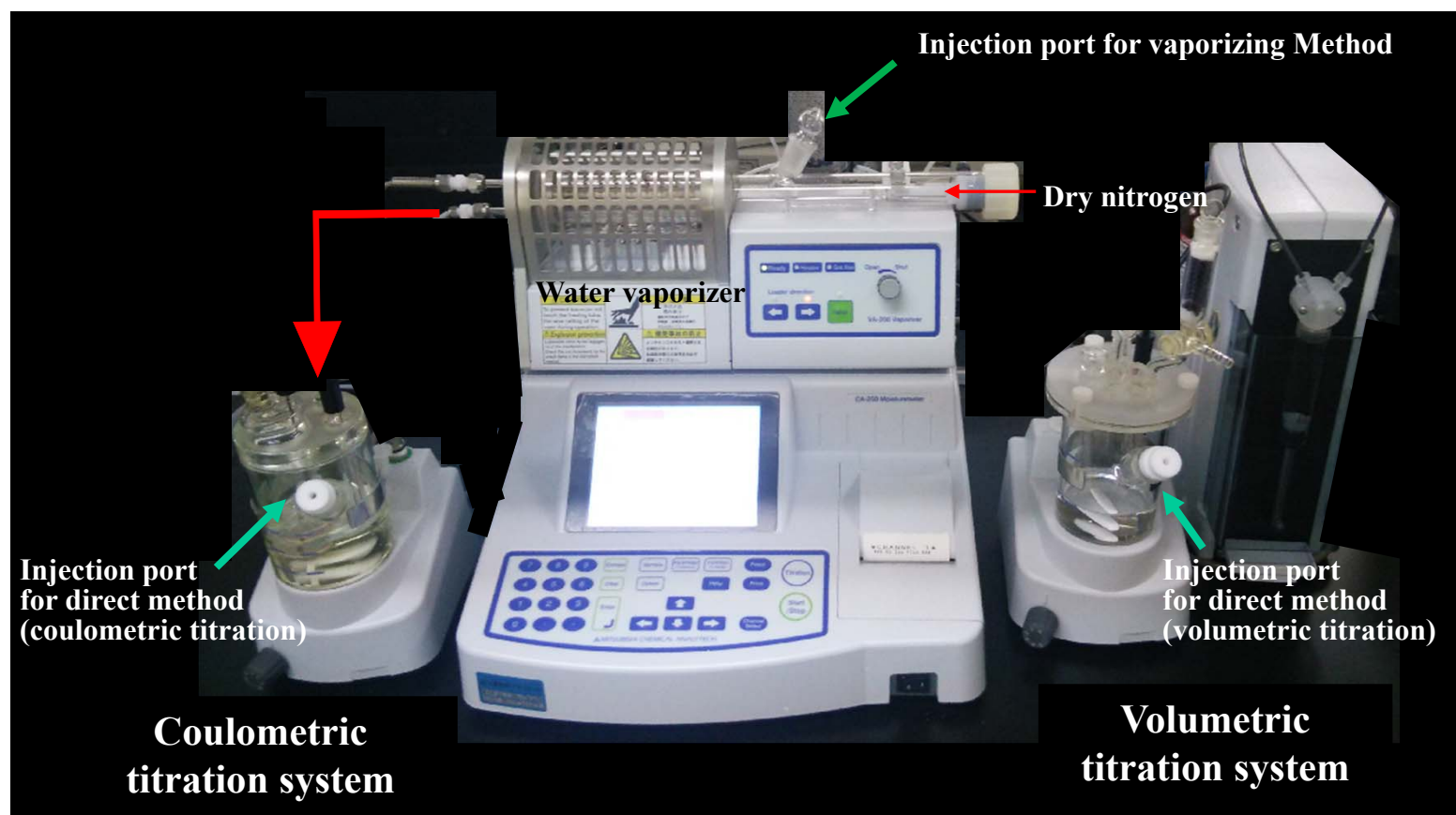# Karl Fischer moisture measurement system

Karl Fischer Method is the method to measure water content in various materials (ex. industrial products, foods, pharmaceutical products).

Injection port for vaporizing Method

Dry nitrogen

Water vaporizer

Injection port
for direct method
(coulometric titration)

Injection port
for direct method
(volumetric titration)

**Coulometric
titration system**

**Volumetric
titration system**

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Principle of Karl Fischer Method

Water reacts with iodine and sulfur dioxide quantitatively, under the presence of alcohol and N-base. This reaction was discovered by Karl Fischer. The reaction formula is shown below.

$$H_2O+I_2+SO_2+ROH+3R'N \rightarrow 2RN \cdot HI+R'N \cdot HSO_4R$$

The loss of iodine is determined with volumetric titration or coulometric titration. The water content is calculated from the loss of the iodine in the reaction above.

Volumetric titration

Weighed sample is injected into dehydration solvent in the titration vessel. Successively titrant containing iodine is dropped into the titration vessel. Water content is calculated from the volume of the titrant reacting with the water.

Coulometric titration

Weighed sample is injected into anolyte containing iodine, alcohol and N-base in the titration vessel. Iodine reacts with water in sample, and generates iodine ion. Water content is calculated from the quantity of consumed electricity to produce iodine from iodine ion.

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Sample injection method in Karl Fischer Method

Direct method ; Liquid or solid sample soluble with anolyte is injected directly to anolyte in titration vessel.

Vaporizing method ; Non-soluble sample is injected into vaporizer. Water vapor generated by heating is blown into anolyte with dry nitrogen gas.

Direct method

Vaporizing method

Sample soluble with anolyte

Non-soluble sample

Furnace

Dry nitrogen

Water vaporizer

Anolyte

Titration vessel
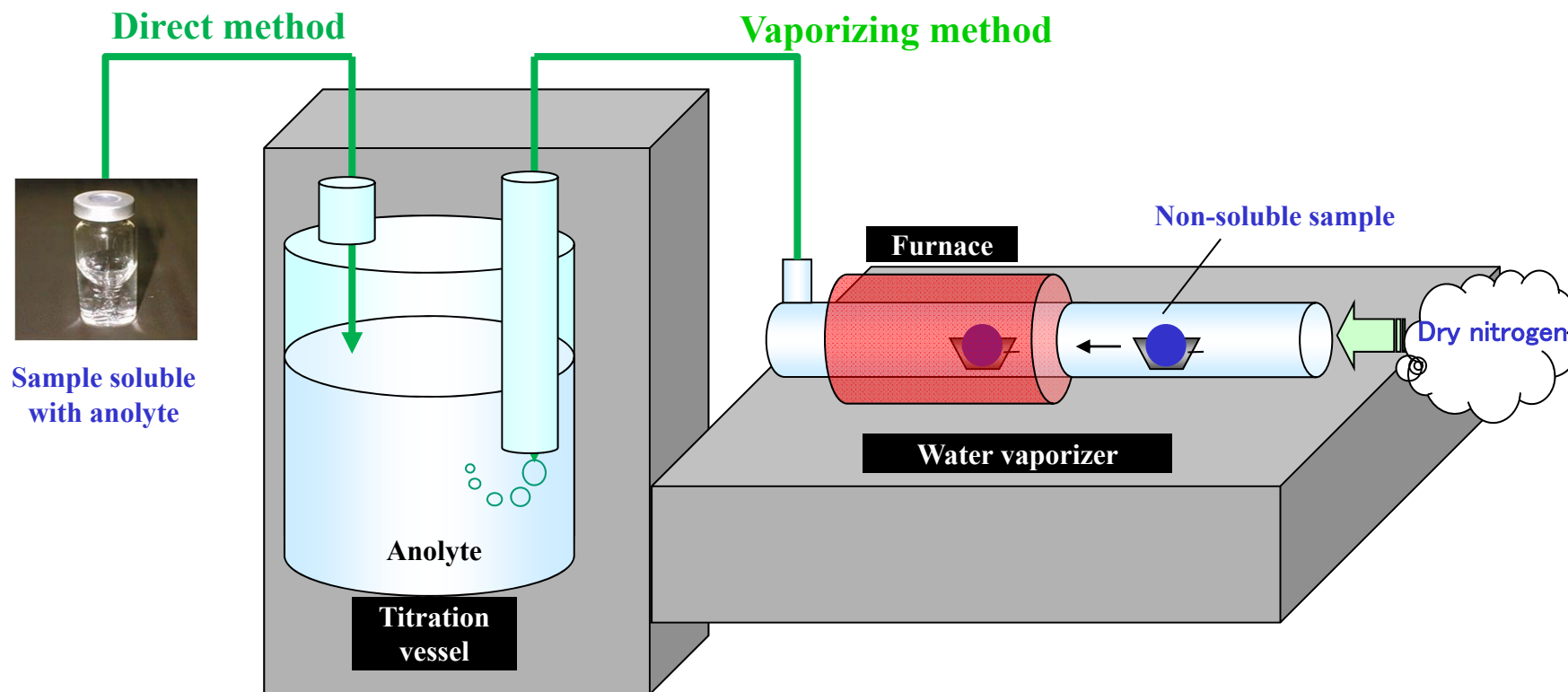
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Applications of Karl Fischer Method

Sample	Number of measurement	Determined water(μg/g)	
		Measurement	Mean
Methanol [Direct Method]	n=1 n=2 n=3 n=4 n=5	510 506 510 508 515	510 (cv 0.7%)

Sample	Number of measurement	Determined water(μg/g)	
		Measurement	Mean
Toluene [Direct Method]	n=1 n=2 n=3 n=4 n=5	63 61 62 63 63	62 (cv 1.1%)

Sample	Number of measurement	Determined water(μg/g)	
		Measurement	Mean
Human hair [Vaporizing Method]	n=1 n=2 n=3 n=4 n=5	11.24 11.17 11.39 11.55 11.14	11.3 (cv 1.5%)

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