資　料

Argon-Alcohol Counting Gas

—As an alternative to Q-gas for a gas-flow counter—

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Argon gas mixed with methanol or ethanol was found to be excellent counting gas for a 2π gas-flow counter. Gas mixing device and GM plateau characteristics were introduced. Surface area of 30~64cm^2 methanol in a flask at 0°C in the midst of argon supply system gave the best plateau characteristic and be recommended as an alternative to Q-gas. The cost of argon is about 1/16 the cost of Q-gas in Japan.

KEYWORDS

Argon-alcohol counting system, Q-gas, 2π gas-flow counter, Counting characteristics.

INTRODUCTION

Q-gas, helium mixed with 4% isobuthane, is widely used for 2π gas flow counter. For a measurement of very low radioactivities in the environmental sample 2π gas-flow counter is quite suitable, especially for the measurement of β or γ radioactivities. The cost of Q-gas will often be expensive, since the counter is usually operated several days long for the measurement of many environmental samples.

Cheaper counting gas was looked for and argon-alcohol mixed gases were examined as an alternative to Q-gas for 2π gas-flow counter, which was found to have excellent counting characteristics.

EXPERIMENTAL PROCEDURE

Fig. 1 shows the gas supply system to the counter. Argon gas for welding work was lead from an argon cylinder through a regulator to a Δ-shaped flask. The flow rate of argon gas was controlled to be 120 bubbles per minute, which corresponded to 73ml/min. Organic solvent liquid was prepared in a flask so as to make a definite evaporation area. The flask was immersed in ice water in a thermos to assure constant evaporation rate at 0°C. Several organic solvent liquids were examined, and methanol and ethanol were found to be appropriate among them. A gas-flow counter made by Fujitsu limited in Japan was used to get GM characteristics. Radioactive source used was natural uranium deposited on a stainless steel disc of which radioactivity was 500 dps (500 Bq). Voltage added was changed from 1 kV to 1.6 kV.

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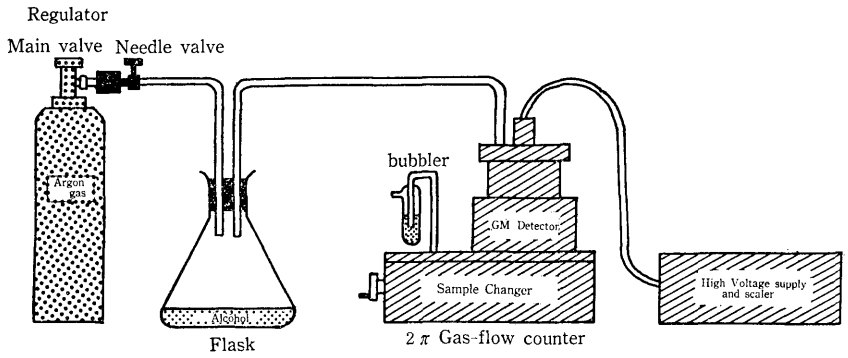

Fig. 1 Argon alcohol mixing system

RESULTS

Fig. 2~Fig. 7 show plateau characteristics of the 2π gas-flow counter using the above argon-alcohol mixed gas. **Fig. 8** shows the one using Q-gas for comparison. The plateau lengths on voltage vs. counting rate curves 100~300 volts. The plateau length for methanol was slightly longer the one for ethanol, and the plateau slope for methanol was smaller than the one for ethanol. Counting characteristic for 30~64 cm^2 methanol evaporation area seems to be the best at our counting condition.

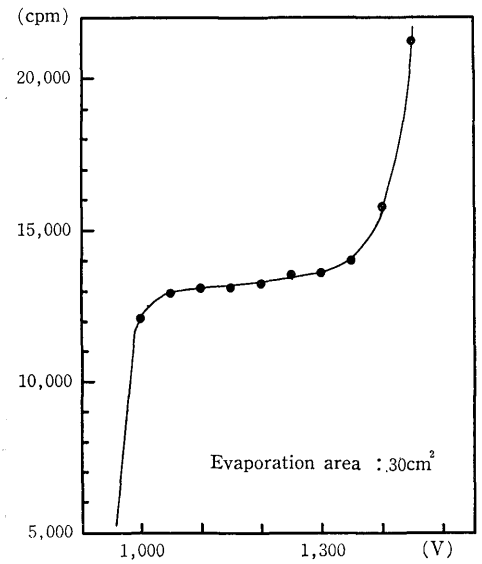

Fig. 2 Plateau Curve for Argon-methanol

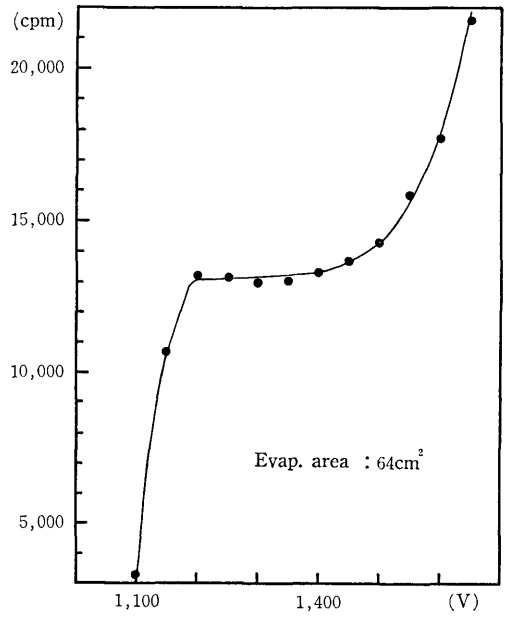

Fig. 3 Plateau Curve for Argon-methanol

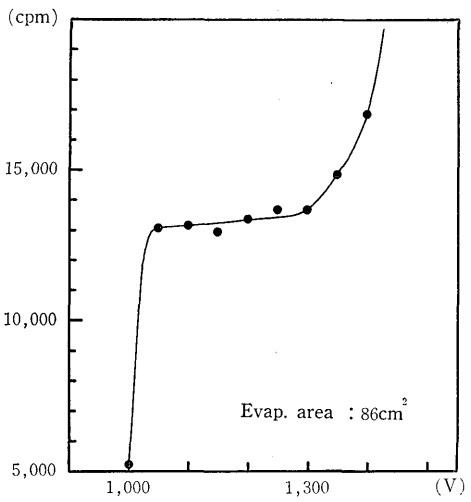

Fig. 4 Plateau Curve for Argon-methanol

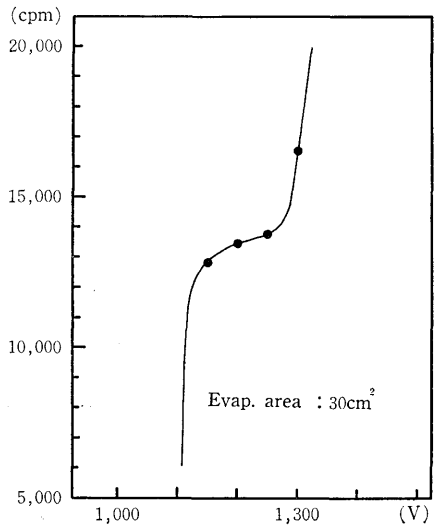

Fig. 5 Plateau Curve for Argon-ethanol

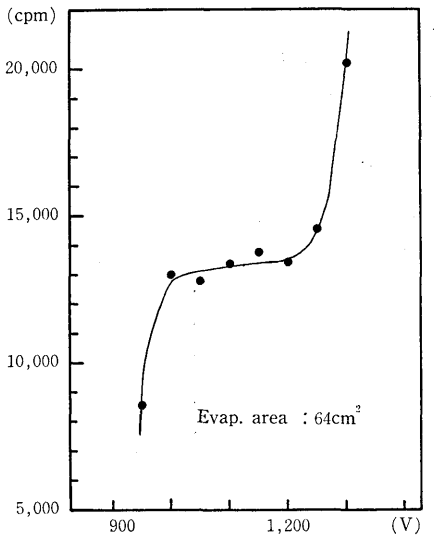

Fig. 6 Plateau Curve for Argon-ethanol

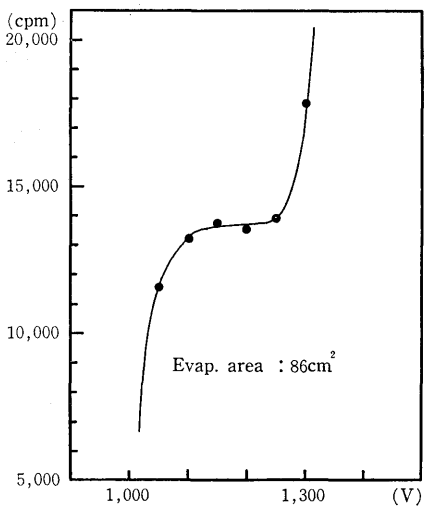

Fig. 7 Plateau Curve for Argon-ethanol

DISCUSSION

Counting characteristics for argon-alcohol system seem to be superior to the one for Q-gas system, as seen in **Table 1.** **Table 2** shows the comparison of costs between argon and Q-gas in Japan. The cost of argon is estimated to be about 1/16 times the cost of Q-gas. Only one thinkable demerit of the system would be the troublesom work of periodic ice cube supply to the thermos

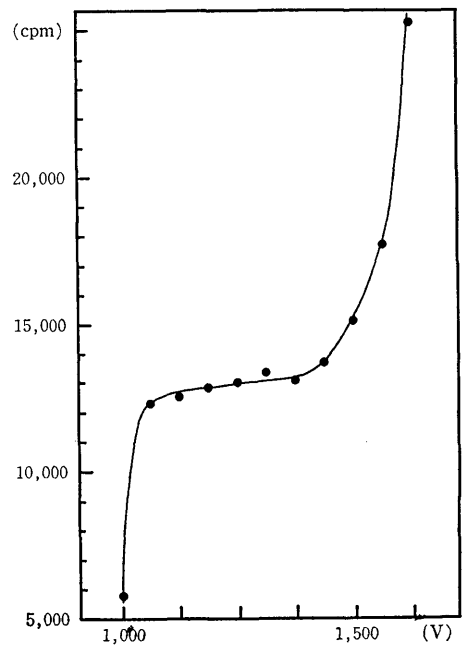

Fig. 8 Plateau Curve for Q-gas

Table 1 Plateau lengths and their slopes

Alcohol	Evaporation area(cm^2)	Plateau length(V)	Plateau slope(%/100V)
Methanol	30	300	1.9
	64	250	1.4
	86	250	1.9
Ethanol	30	100	9.5
	64	200	1.6
	86	150	3.5
Q-gas		300	3.7

Table 2 Cost Comparison of argon gas and Q-gas

	Argon gas cylinder	Q-gas cylinder
Volume (litre)	52	10
Pressure (kg/cm^2)	150	110
Gas volume at 1 kg/cm^2(litre)	7800	1100
Cost for one cylinder (¥)	10000	22000
Cost per litre (yen)	1.28	20