^{85}Krによる地下水年代測定のための地下水からの溶存Krの抽出について

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Abundance of Kr in air

- Volume fraction of noble gases in dry air

  He: $(5.24 \pm 0.05) \times 10^{-6}$

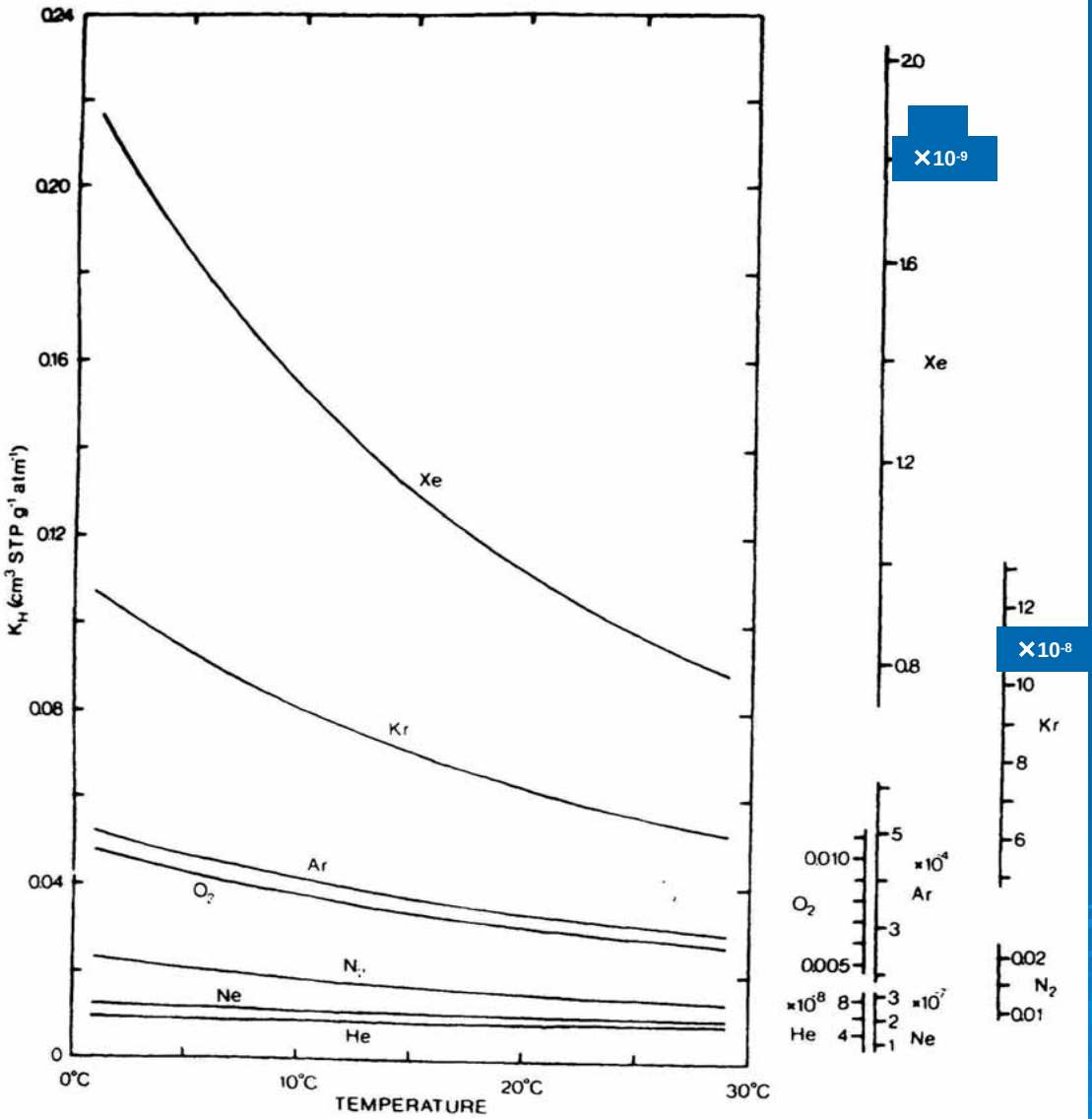
  Ne: $(1.818 \pm 0.004) \times 10^{-5}$

  Ar: $(9.34 \pm 0.01) \times 10^{-3}$

  Kr: $(1.14 \pm 0.01) \times 10^{-6}$

  Xe: $(8.7 \pm 0.1) \times 10^{-8}$

Fig. 7.1. Solubility of gases in pure water, from Table 7.1 (N_2, Ar) and Table 7.3 (He, Ne, O_2, Kr, Xe). Ordinate of main figure is Henry's Law solubility. Ordinate scales at right show concentrations (in cm^3 STP/g) for equilibrium with 760 torr *dry air* with composition given in Table 2.1.



Kr in groundwater

- Abundance of Kr (cm^3 STP/g) in water
  (Air saturation)
  - Frshwater: 12.57×10^{-8} (0 ºC)
    6.22×10^{-8} (25 ºC)
  - Seawater: 9.05×10^{-8} (0 ºC)
    4.74×10^{-8} (25 ºC)
  - Groundwater: $5.42 \sim 8.4 \times 10^{-8}$ (Israel)
    $8.14 \sim 12.3 \times 10^{-8}$ (Japan)

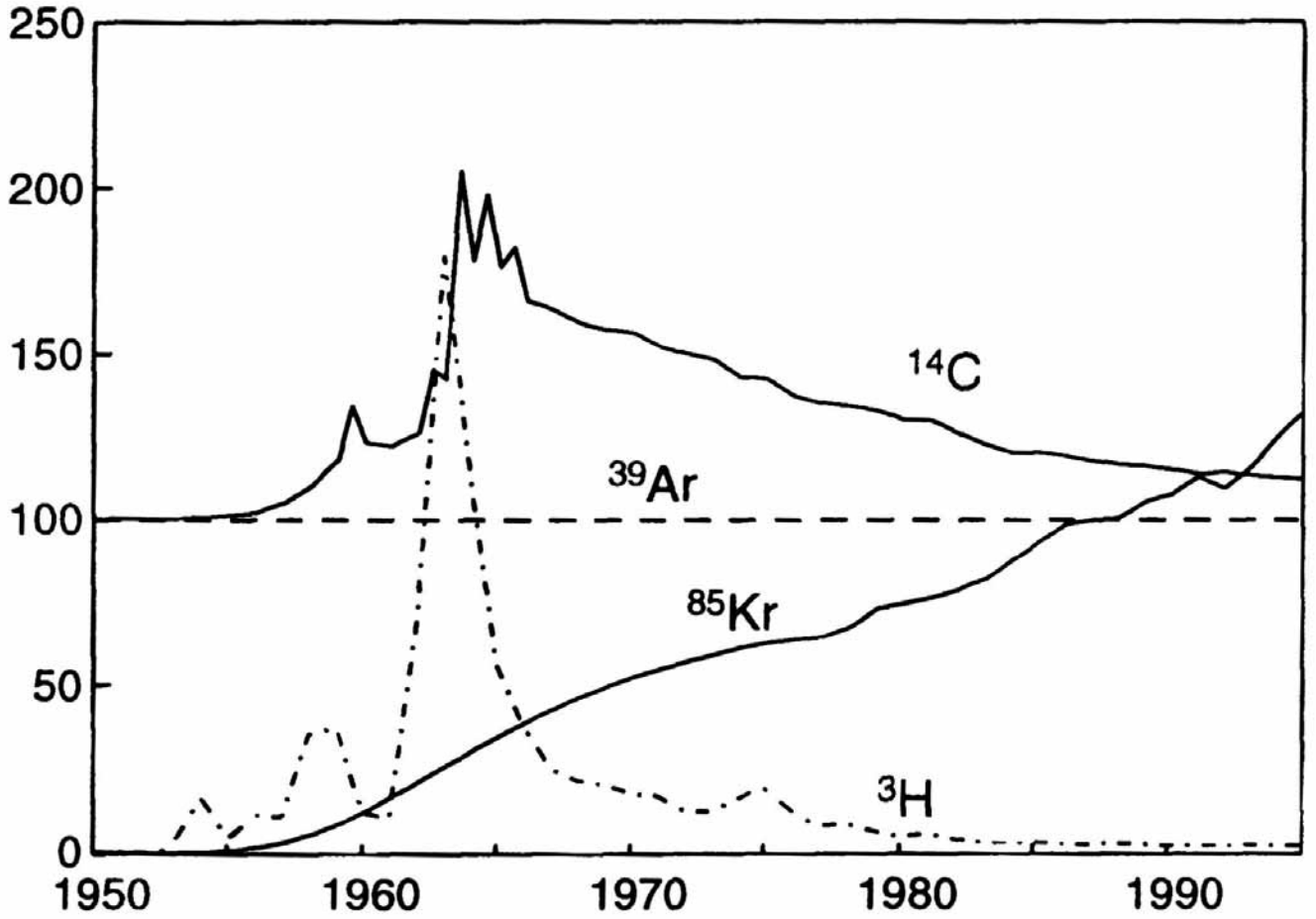


Figure 12.1 ^{85}Kr activity of tropospheric air between 1950 and 1995 compared to those of ^{39}Ar and ^{14}C, and to ^{3}H data representative for precipitation in central Switzerland. The vertical scale factors are: 100 = 1 Bq m^{-3} of air for ^{85}Kr, 100 % modern for ^{39}Ar (equal to 1.67 x 10^{-2} Bq m^{-3} of air), 100 pmC for ^{14}C, and 1000 TU for ^{3}H.

Radioisotopes of Kr in groundwater

- ^{85}Kr (half-life:10.76 years)

  origin: nuclear installations

  8.6×10^{-5} Bq/L (7×10^{-8} ccSTP/g water,

  equilibrated with modern dry air at 25ºC)

  $^{85}Kr/Kr_{(atoms)}$:7.1×10^{-19}

- ^{81}Kr (half-life:2.29×10^{5} years)

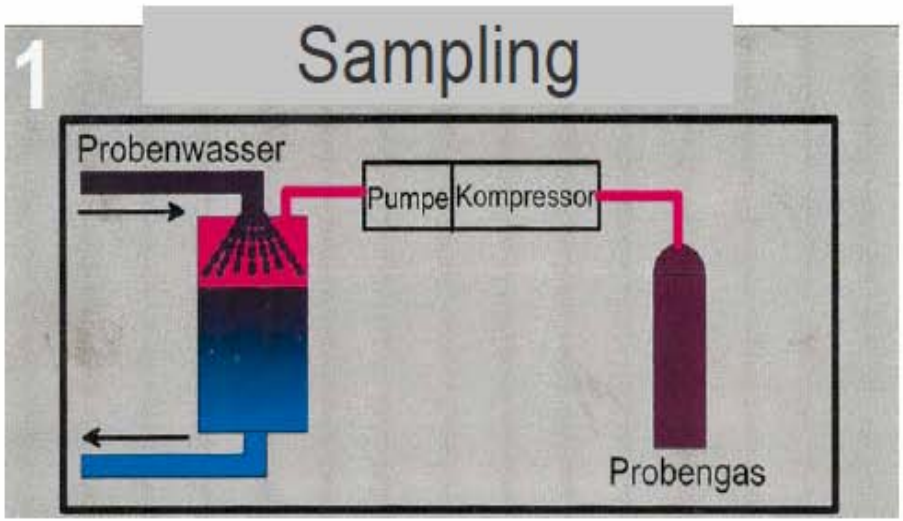
  origin: cosmogenic

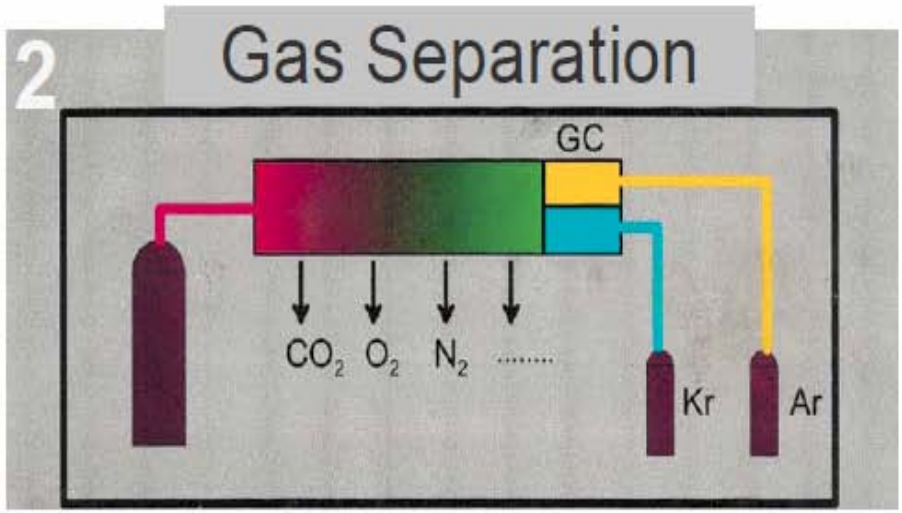
  9.5×10^{2} atoms/L (7×10^{-8} ccSTP/g water

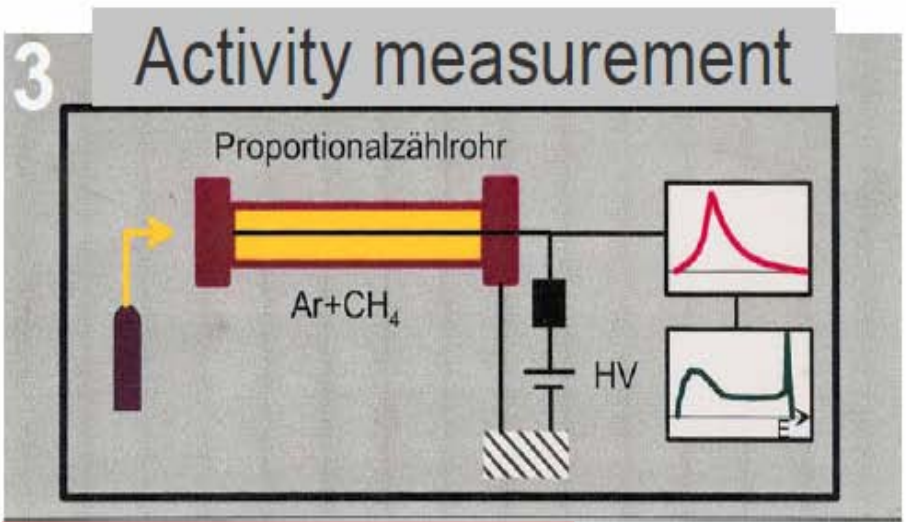
  equilibrated with modern dry air at 25ºC)

  $^{81}Kr/Kr_{(atoms)}$:5.05×10^{-13}

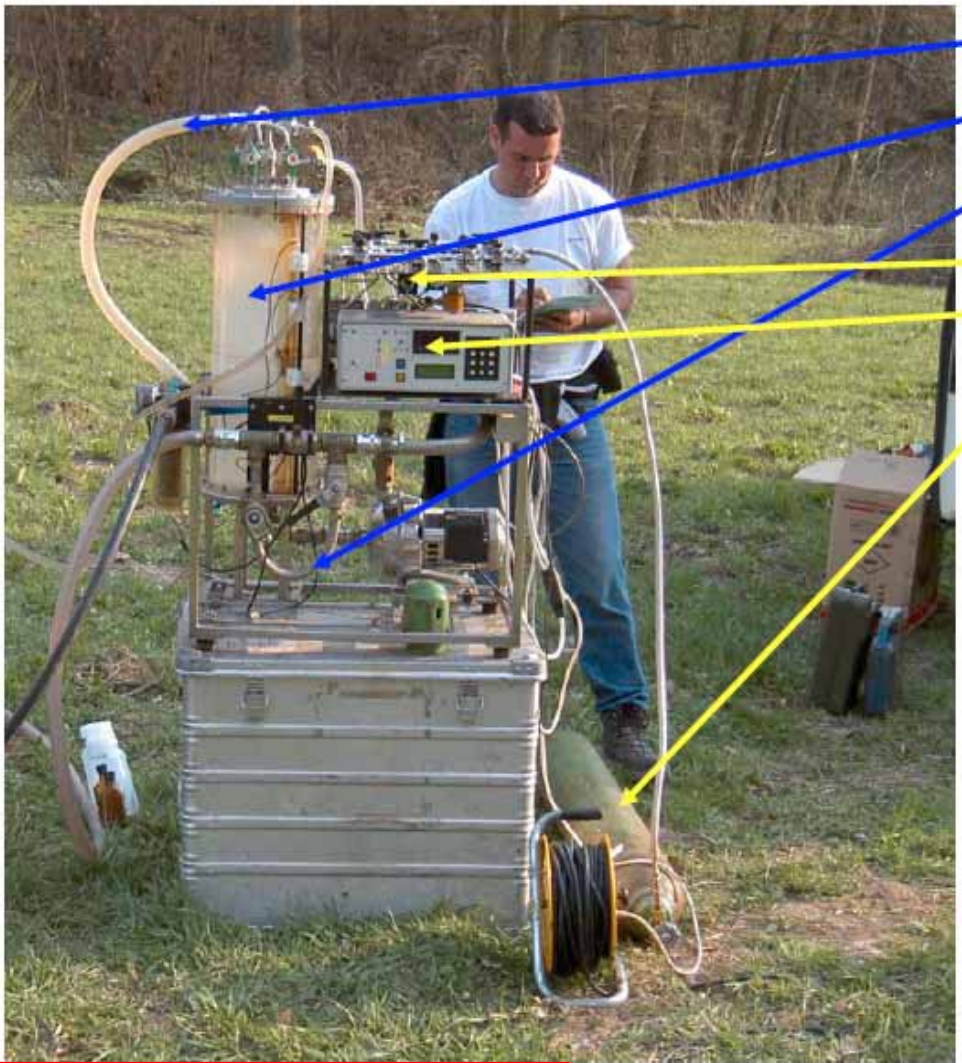
Technical Procedure (LLC)







Sampling of ^{39}Ar



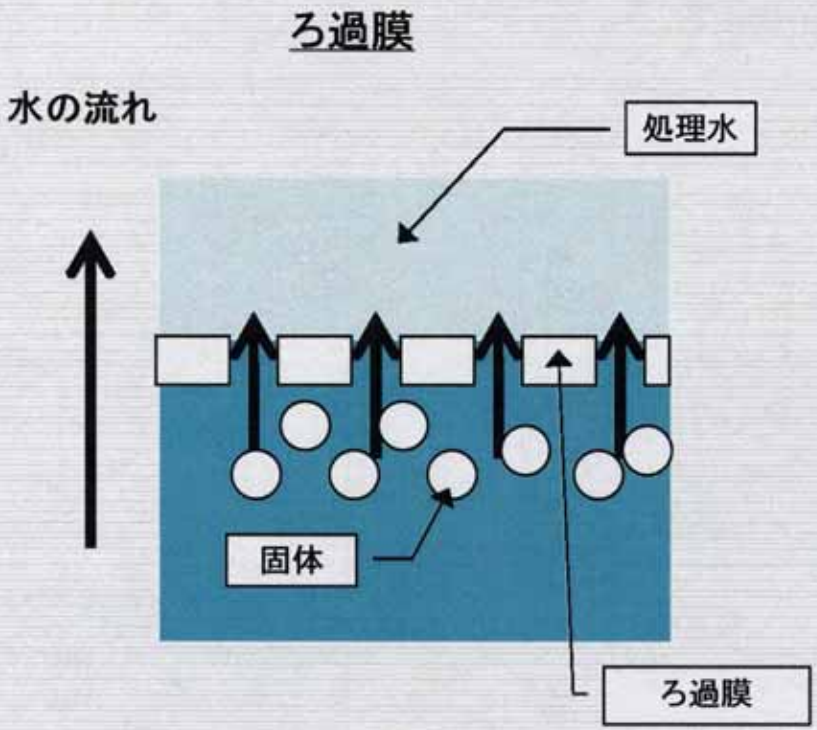
Water inlet
Extraction cylinder
Water outlet
Pumps, Kompressor
Electronic contoller
Sample tank

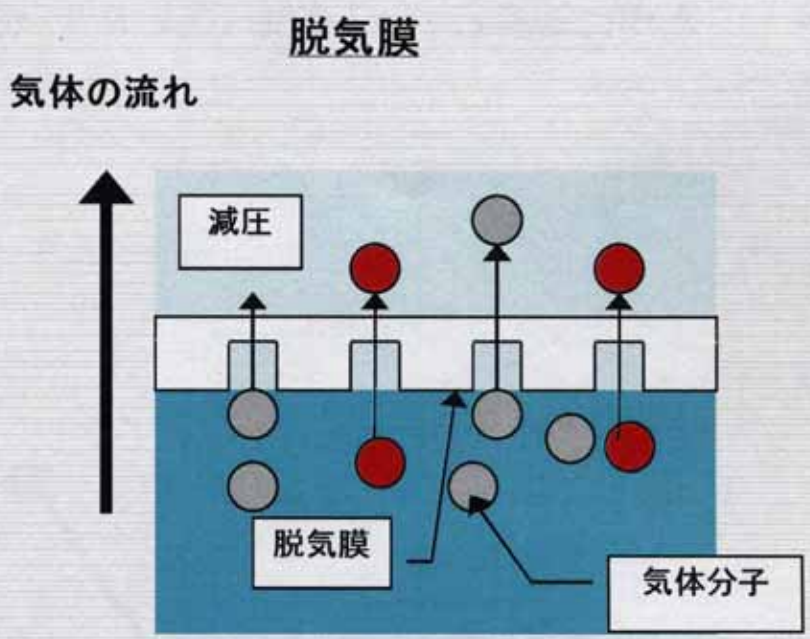
Sample Size:	2-5 tons of water
Water flux:	max 25L/min
Extraction time:	min 1.5 h

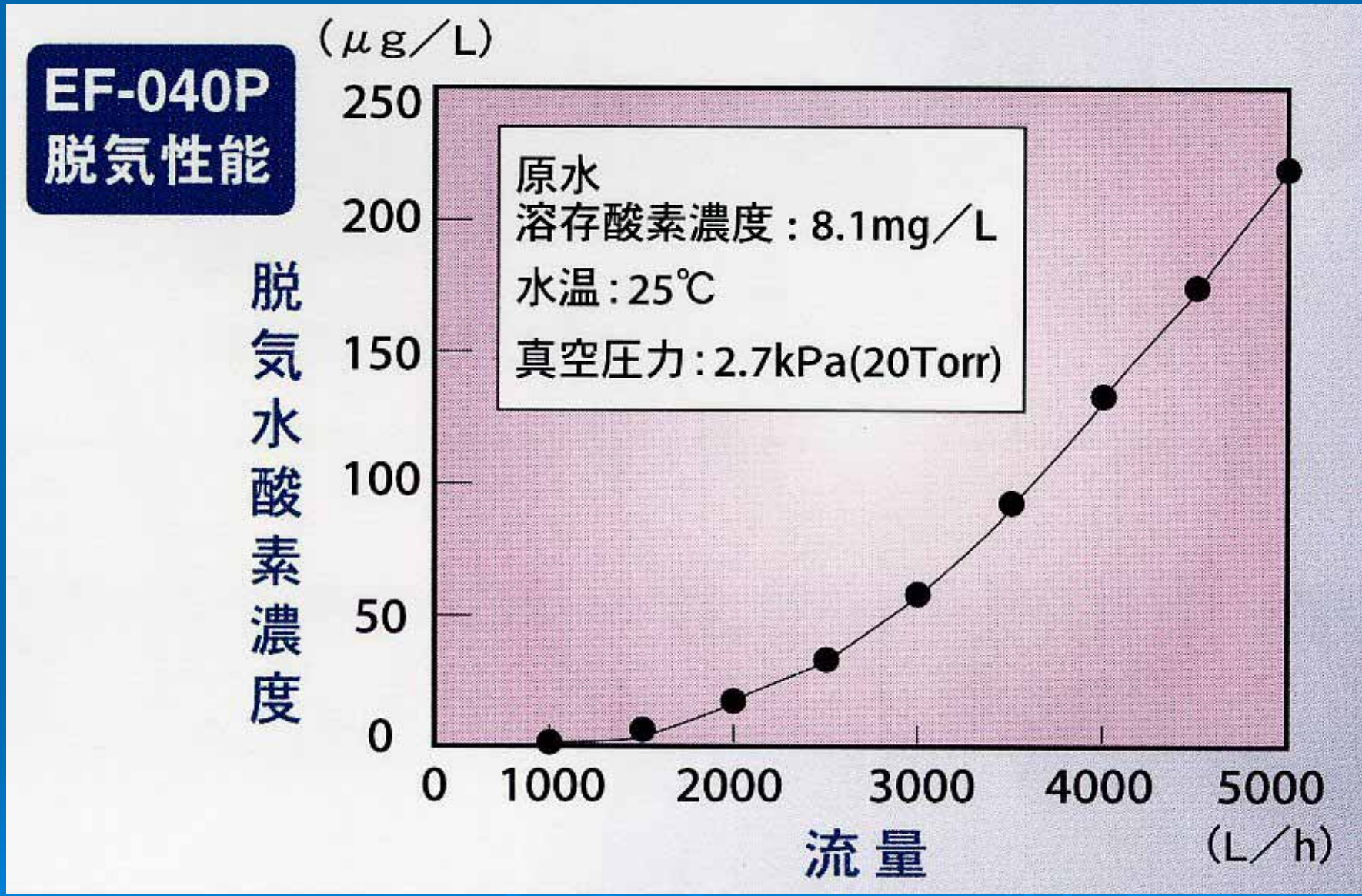
Diffusion coefficients of dissolved gases in water ($cm^2/sec \times 10^5$)

T (ºC)	5	10	25	30
He	5.10	5.74	7.22	8.48
Ne	2.61	2.94	4.16	4.82
Ar	1.63	1.97	2.69	3.29
Kr	1.02	1.20	1.84	2.40
Xe	0.774	0.929	1.47	1.94
N_2	-	1.4	-	3.47
O_2	-	-	-	3.49

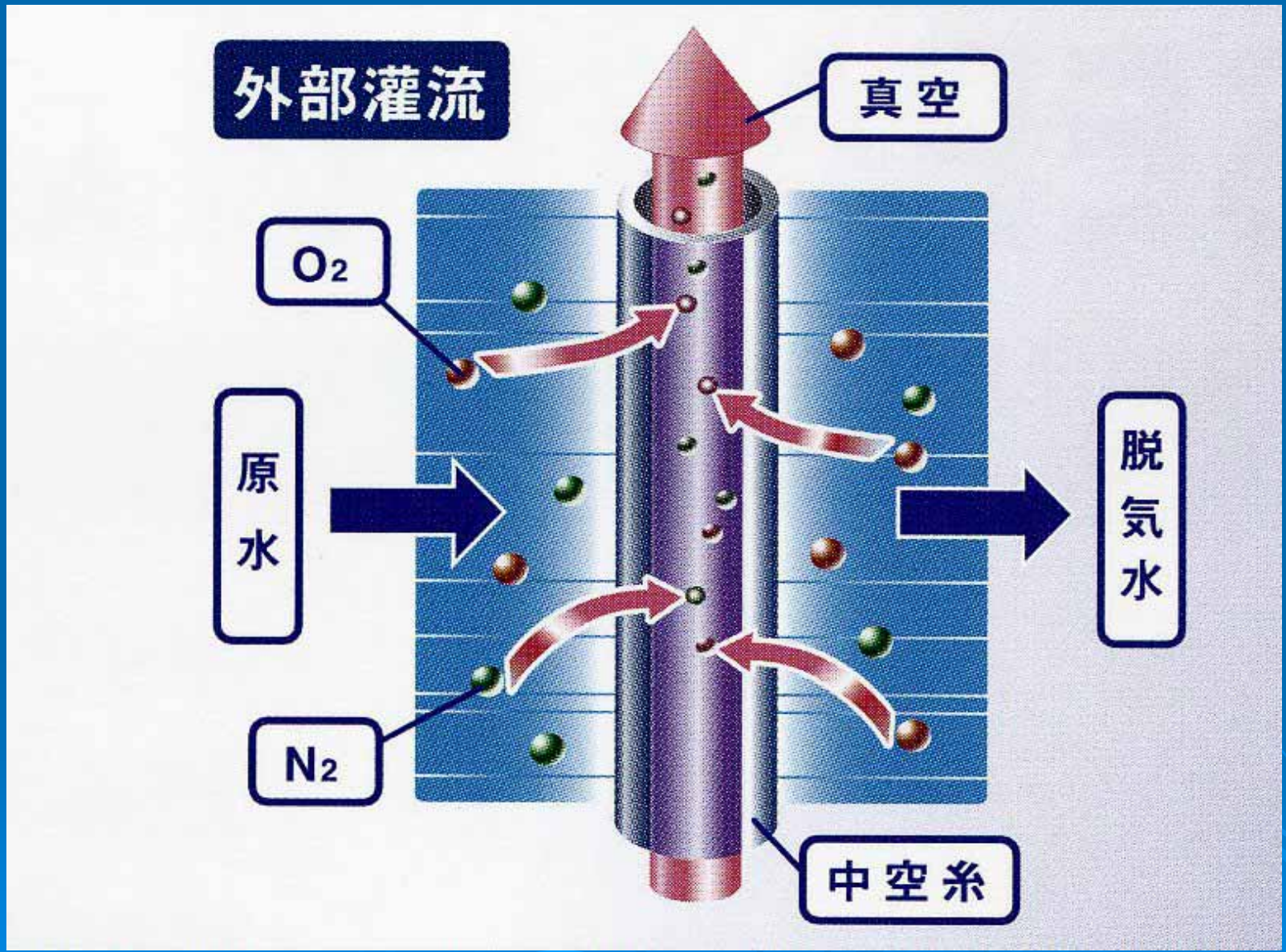
ろ過膜と脱気膜の違い

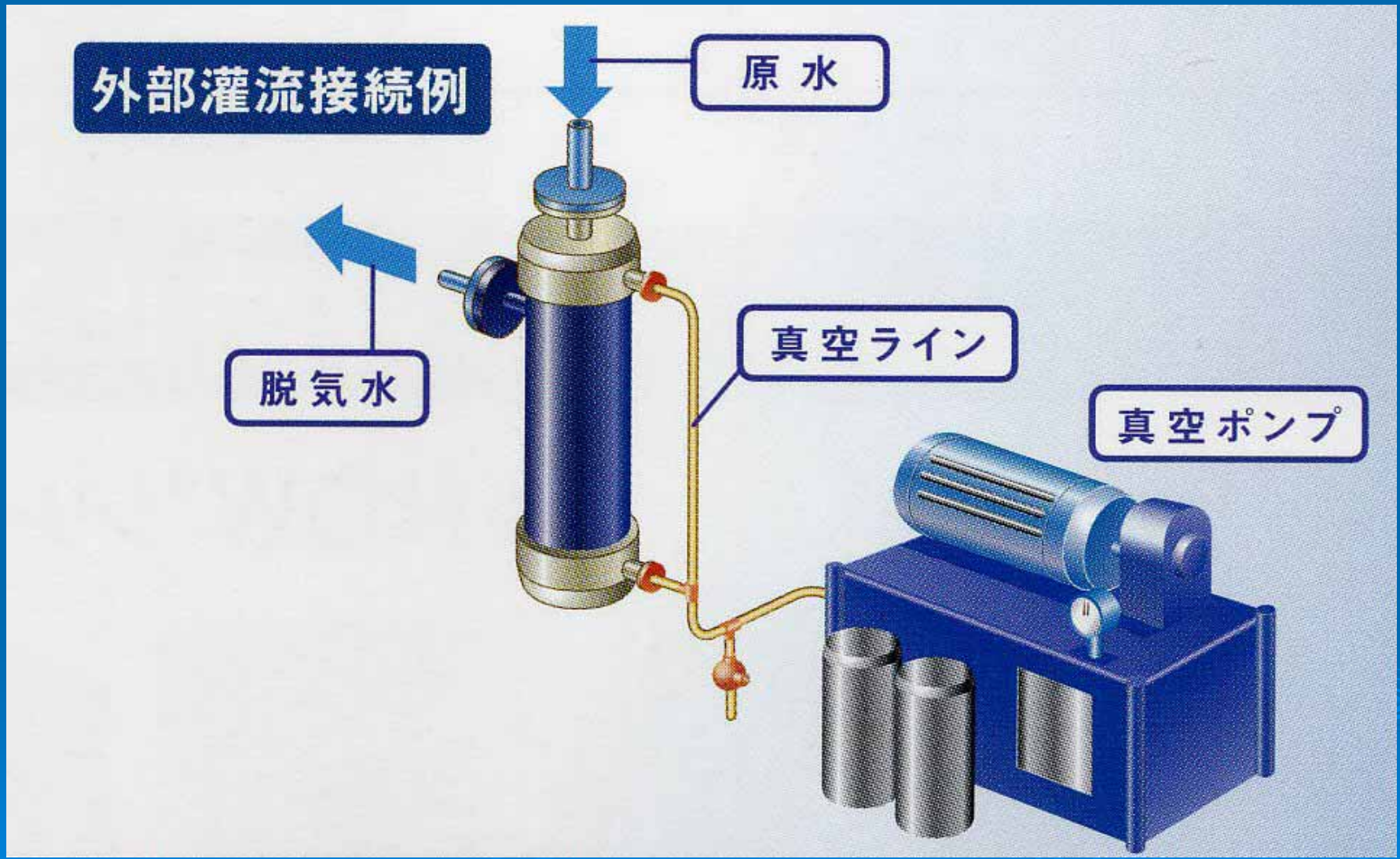


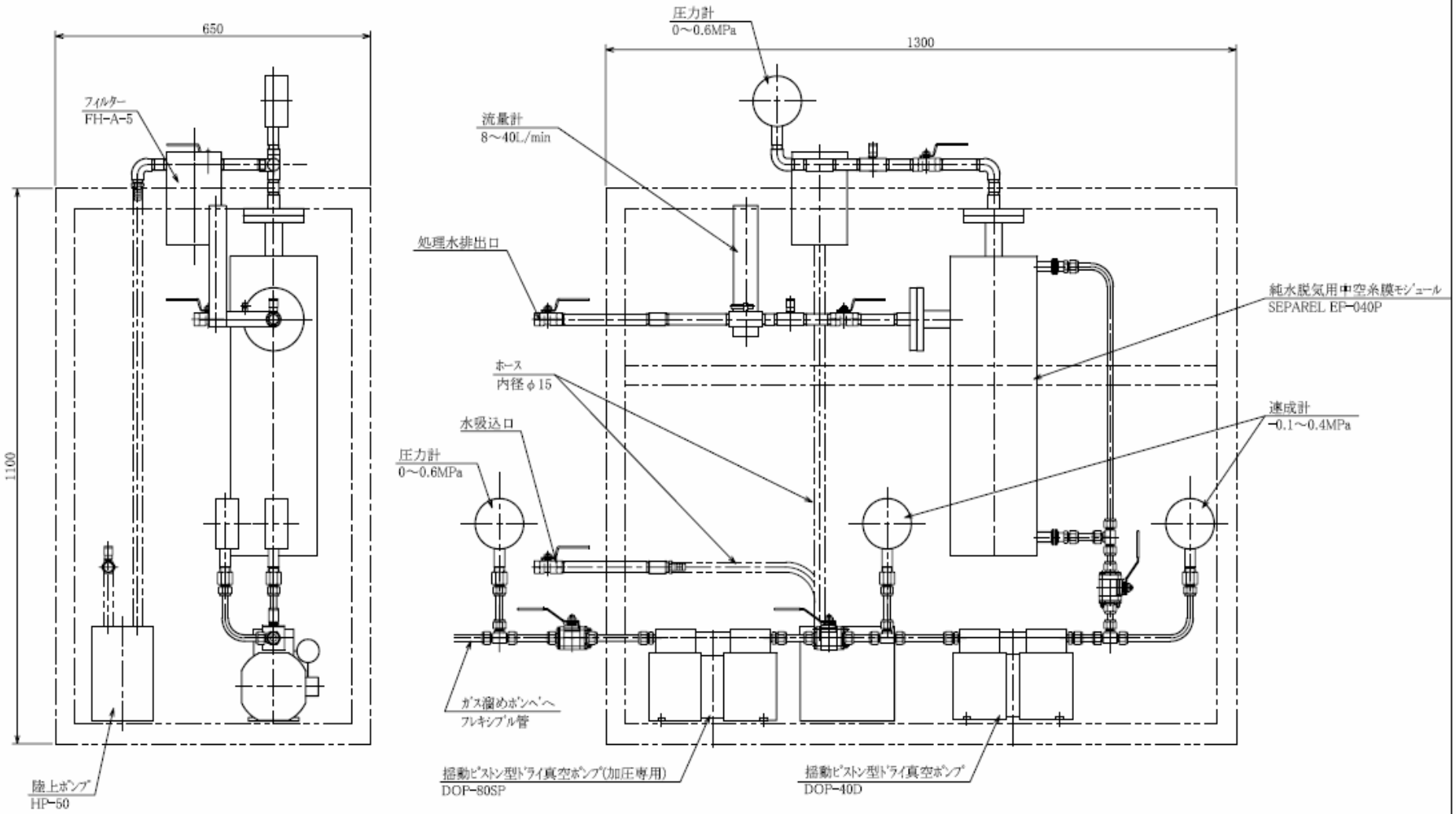




1Torr=1mmHg=133.32 Pa=1.33x10^{-3} bar=1.33 mbar


外部灌流
真空
O2
原水
脱気水
N2
中空糸


外部灌流接続例
原 水
脱気水
真空ライン
真空ポンプ



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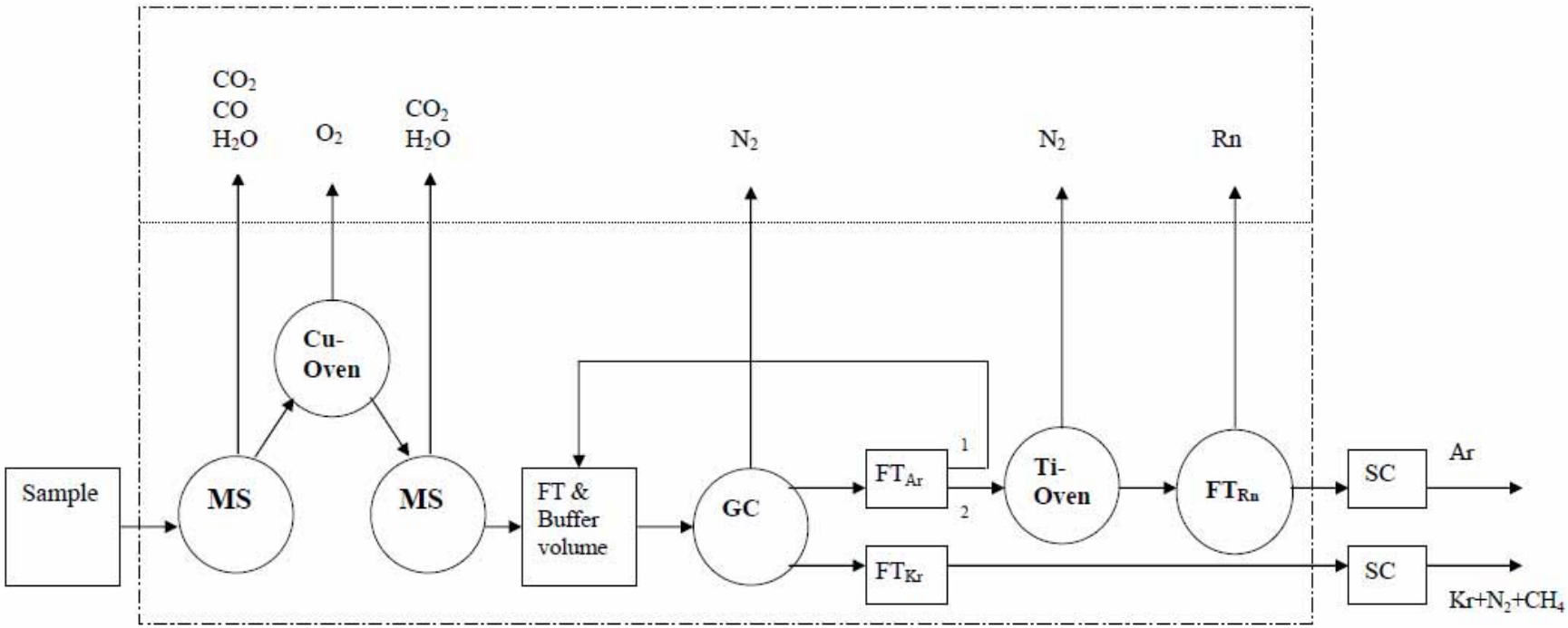
日付 DATE	検図 CHECKED			
第3角法 3RD ANGLE PROJECTION	承認 APPROVED			

TITLE: 地下水サンプルガス抽出装置

DWG. NO. A300175

堀口鉄工所

Sample preparation



MS: Molecular sieve
FT: Freezing trap

まとめ

- 分析に必要なガス量としては、10トンの地下水からKrとして、約1ccSTP程度回収できる。
- ^{85}Krの放射能としては:約　1Bq 程度
  (測定可能な範囲)
- 今後の課題:回収率をどこまで上げれるか
  分離膜の劣化(水質)