$$1.4586r^3-3.6124r^2+0.7531r=0$$

$$r=0.231$$

$$\lambda_1\left\{r-\frac{4}{3}\times\frac{11}{191}(1-r)+\frac{r(1-r)}{0.13384}\times 0.0298317\right\}+\lambda_7\left\{\frac{4}{3}\times\frac{11}{191}+\frac{r}{0.13384}\times 0.236478\right\}=0$$

$$\lambda_1\left\{\frac{4}{3}\times\frac{11}{191}(1-r)+\frac{r(1-r)}{0.13384}\times 0.236478\right\}+\lambda_7\left\{-\frac{3}{4}\times\frac{11}{191}+\frac{r}{0.13384}\times 0.372014\right\}=0$$

$$\lambda_1\{r-0.0767(1-r)+r(1-r)\times 0.2228\}+\lambda_7\{0.0767+1.7658r\}=0$$

$$\lambda_1\{0.0767(1-r)+1.7668r(1-r)+\lambda_7\{-0.0767+2.778r\}=0$$

Similary

$\therefore$ $r=0.391$

then,

$$k_1=2.16\times 10^6 \quad I_1=0.1338 \quad r=0.231$$

$$P_1=\sqrt{\frac{0.231\times 2.16\times 10^6}{0.1338}}=1931.1$$

$$f_1=\frac{1931.1}{2\times 3.1416}=307.34\text{cycle/sec}$$

$$k_2=4.51\times 10^6 \quad I_2=0.1338 \quad r_2=0.391$$

$$P_2=\sqrt{\frac{0.391\times 4.51\times 10^6}{0.1338}}=3630.3$$

$$f_2=\frac{3630.3}{2\times 3.1416}=577.78\text{cycle/sec}$$

By compairing f_1, and f_2 we gain the following conclusion,

(3) Conclusion

In this discussion the free torsional vibration of shaft was considered and the frequencies of the natural vibrations were deter mined. When we changed the position of cams at the nearest position of the bearing, the torsional vibrations shall have the least valve of the vibration and then the least impact on the shaft.

We belieued that this changed positions of cams shall have the best conditions for the vibration by calculating the above two example.

On the physical properties under the chemical treatment of leathers.

K. OKUDA, I. TSUJIMOTO.

(An Abstract)

In this discussion, our objects are satisfied by researching the chemical and physical properties of leathers on their stress-strain curves, and comparision of their energies under various condition.

(1) Introduction

We compaired the strength of leathers with each other under various thickness as follow.

We took several test-pieces under dry condition.

By tensile testing machine we measured the mechanical properties under its constant pulling speed and we gained the following results.

(2) The expansion theory of the plastic deformation.

If a material has not the plastic deformation, the material which have the deformation ξ will be satisfied by the following equation having the speed deformation.

$$\frac{d\in}{dt}=r=\frac{1}{\mu}\frac{d\tau}{dt}$$

In which, μ=modulus of elasticity in the twist. In order to the plastic flow, the speed deformation will be more occured largely. Assuming that the amount is propertional to the stress, we obtain the next equation.

$$\frac{d\xi}{dt}=\frac{1}{\varepsilon}\frac{d\sigma}{dt}+\frac{\sigma}{\zeta}\quad\cdots\cdots(1)$$

In which, ξ=percentage of elongation, ε=modulus of elasticity. This equation is Maxwell's equation. If we more generalize this equation, that is, if we put σ^n for σ, we can gain the following equation.

$$\frac{d\xi}{dt}=\frac{1}{\varepsilon}\frac{d\sigma}{dt}+\frac{\sigma^n}{\zeta}\quad\cdots\cdots(2)$$

When the amplitude of the vibration is very small, we can assume that the deformation ξ will vibrate with the amplitude a

$$\xi=ae^{i\omega t}$$

In the practical vibration, this equation will be satisfied by the real part.

Similarly $\sigma=\sigma_0e^{i\omega t}$

In which, σ_0 means the complex number in general.

Then,

$$\frac{d\sigma}{dt}=\sigma_0 i\omega e^{i\omega t}$$

$$\frac{d\xi}{dt}=ai\omega e^{i\omega t}$$

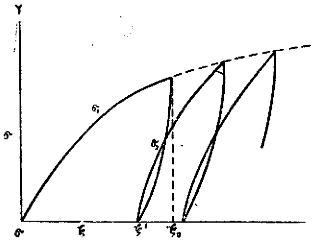

Fig. 1

The equation (2) will be became as the next form.

$$ia\omega=\sigma_0\left\{\frac{1}{\varepsilon}i\omega+\frac{\sigma_0^{n-1}}{\zeta}(e^{i\omega t})^{n-1}\right\}\quad\cdots\cdots(3)$$

now, $n=1$

$$\zeta_0=\frac{ia\omega}{\left\{\frac{1}{\varepsilon}i\omega+\frac{1}{\zeta}\right\}}=\left[\frac{\omega^2}{\left\{\frac{\omega^2}{\varepsilon^2}+\frac{1}{\zeta^2}\right\}\varepsilon}+i\frac{\omega}{\zeta\left\{\frac{\omega^2}{\varepsilon^2}+\frac{1}{\zeta^2}\right\}}\right]\quad\cdots\cdots(4)$$

$$=(T'+T''i)a$$

in which, $i=\sqrt{-1}$

next, $n=2$

$$ia\omega=\sigma_0\left\{\frac{1}{\varepsilon}i\omega+\frac{\sigma_0}{\zeta}e^{i\omega t}\right\}\quad\cdots\cdots(5)$$

$$\varepsilon e^{i\omega t}\sigma_0^2+i\omega\zeta\sigma_0-\varepsilon\zeta ia\omega=0$$

$$\therefore\quad \varepsilon(\cos\omega t+i\sin\omega t)\sigma_0^2+i\omega\zeta\sigma_0-\varepsilon\zeta ia\omega=0$$

$$\therefore\quad \sigma_0=\frac{-i\omega\zeta\pm\sqrt{-\zeta^2\omega^2+4\varepsilon^2\zeta ia\omega(\cos\omega t+i\sin\omega t)}}{2\varepsilon(\cos\omega t+i\sin\omega t)}$$

$$=\frac{i\omega\zeta\pm\sqrt{(-\zeta^2\omega^2-4\varepsilon^2\zeta a\omega\sin\omega t)+i4\varepsilon^2\zeta a\omega\cos\omega t}}{2\varepsilon(\cos\omega t+i\sin\omega t)}$$

now, putting as the following form.

$$\sqrt{(-\zeta^2\omega^2)-4\varepsilon^2\zeta a\omega\sin\omega t)+i4\varepsilon^2\zeta a\omega\cos\omega t}=A+iB$$

we oftain

$$A=\pm\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2+8\zeta\varepsilon^2a\sin\omega t}\}}$$

$$B=\pm\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^2a^2+8\zeta\omega\varepsilon^2a\sin\omega t}\}}$$

$$\therefore\quad \sigma_0=\frac{-i\zeta\omega\pm\left[\pm\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^2a^2+8\zeta\omega\varepsilon^2a\sin\omega t}\}}\right.\pm i\left.\frac{4\varepsilon^2a\cos\omega t\cdot\zeta\omega}{\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2+8\zeta\omega\varepsilon^2a\sin\omega t}}}\right]}{2\varepsilon(\cos\omega t+i\sin\omega t)}\quad\cdots\cdots(6)$$

$$\therefore\quad \sigma_0=\frac{1}{2\varepsilon}\Big[\pm\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2+8\zeta\omega\varepsilon^2a\sin\omega t}\}}\cos\omega t$$

$$+\left\{-\zeta\omega\pm\frac{4\varepsilon^2a\sqrt{\zeta\omega}\cos\omega t}{\sqrt{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2 8\zeta\omega\varepsilon^2a\sin\omega t}}}\right\}\sin\omega t\Big]$$

$$+i\frac{1}{2\varepsilon}\Big[\left\{-\zeta\omega\pm\frac{\sqrt{\zeta\omega}\cdot4\varepsilon^2a\cos\omega t}{\sqrt{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2+8\zeta\omega\varepsilon^2a\sin\omega t}}}\right\}\cos\omega t$$

$$\pm\frac{1}{\sqrt{2}}\sqrt{\zeta\omega\{-(\zeta\omega+4\varepsilon^2a\sin\omega t)\pm\sqrt{\zeta^2\omega^2+16\varepsilon^4a^2+8\zeta\omega\varepsilon^2a\sin\omega t}\}}\sin\omega t\Big]\quad\cdots\cdots(7)$$

$$=T'+iT''$$

$$\sigma_0e^{i\omega t}=(T'+iT'')\{\cos\omega t+i\sin\omega t\}$$

$$=aE'\cos\omega t+aiE''\cos\omega t+iE'\sin\omega t-aE''\sin\omega t$$

$$\therefore\quad \sigma=(T'+iT'')\{\cos\omega t+i\sin\omega t\}$$

$$=T'\cos\omega t+iT''\cos\omega t+iT'\sin\omega t-T''\sin\omega t$$

$$=T'\cos\omega t-T''\sin\omega t+i(T''\cos\omega t+T'\sin\omega t)$$

$$\therefore\quad F(\sigma)=T'\cos\omega t-T''\sin\omega t$$

$$F(\xi)=a\cos\omega t$$

$$Q=\int_0^{\frac{2\pi}{a}}F(\sigma)\frac{dF(\xi)}{dt}dt=\int_{\frac{2\pi}{\omega}}^{0}\{T'\cos\omega t-T''\sin\omega t\}\sin\omega t=\int_0^{\frac{2\pi}{\omega}}(T''\sin\omega t-T'\cos\omega t)\sin\omega t\,dt$$

If $\dot{n}=1$,

$$Q=\int_0^{\frac{2\pi}{\omega}}F(\sigma)\frac{dF(\xi)}{dt}dt=\pi a^2\frac{\omega}{\zeta\left\{\frac{\omega^2}{\varepsilon^2}+\frac{1}{\zeta^2}\right\}}$$

In that case, that is, when $n=2$, $n=3$, ……etc.

ı is better to obtain the emperical formula for $F(\sigma)$, and we can find the loss energy Q for one cycle, and then it is desired to compair the loss energy of every test-pieces.

(3) The theory of the mechanical properties on leathers.

In the following equation, when we assume

$$\frac{d\xi}{dt}=\frac{1}{\varepsilon}\frac{d\sigma}{dt}+\frac{\sigma^n}{\zeta}$$

and $\qquad\frac{d\sigma}{dt}=\dot{\xi}\frac{d\sigma}{d\xi}\qquad k=\frac{\varepsilon}{\zeta}$

$$\therefore\quad \dot{\xi}=\frac{1}{\varepsilon}\dot{\xi}\frac{d\sigma}{d\xi}+\frac{k\sigma^n}{\varepsilon}=\frac{1}{\varepsilon}\left\{\dot{\xi}\frac{d\sigma}{d\xi}+k\sigma^n\right\}$$

$$\dot{\xi}\frac{d\sigma}{d\xi}=\varepsilon\dot{\xi}-k\sigma^n$$

$$\frac{d\sigma}{d\xi}=\varepsilon-k\frac{\sigma^n}{\dot{\xi}}$$

now when, $\quad n=1$

$$\frac{d\sigma}{d\xi}=\varepsilon-k\frac{\sigma}{\dot{\xi}}$$

assuming that $\sigma=0$ when $\xi=0$,

$$\sigma=\zeta\dot{\xi}\left(1-\zeta^{-\frac{k\xi}{\dot{\xi}}}\right)$$

$$=\zeta\dot{\xi}\left[\frac{k\xi}{\dot{\xi}}-\frac{1}{\underline{|2}}\left(\frac{k\xi}{\dot{\xi}}\right)^2+\frac{1}{\underline{|3}}\left(\frac{k\xi}{\dot{\xi}}\right)^3\cdots\cdots\cdots\right]$$

assuming that $\dot{\xi}=\text{const}$

and when

$$^3\sigma=\sigma_0,\quad \xi=\xi_0,\quad \sigma_1=a\xi+b\xi^2$$

$$-\frac{\dot{\xi}}{k}\log\left\{\varepsilon-\frac{k\sigma}{\dot{\xi}}\right\}=\xi+\log K$$

$$\log K=-\frac{\dot{\xi}}{k}\log\left\{\varepsilon-\frac{k\sigma_0}{\dot{\xi}}\right\}-\xi_0$$

$$\therefore\quad \zeta=\xi_0+\frac{\dot{\xi}}{k}\log\left\{\frac{\sigma_0-\dot{\xi}\zeta}{\sigma-\dot{\xi}\zeta}\right\}$$

$$e^{\frac{k}{\dot{\xi}}(\xi-\xi_0)}=\frac{\sigma_0-\dot{\xi}\zeta}{\sigma-\dot{\xi}\zeta}$$

not work

$$\therefore\quad \sigma_2=(\sigma_0-\dot{\xi}\zeta)e^{-\frac{k}{\dot{\xi}}(\xi-\xi_0)}+\dot{\xi}\zeta \qquad \zeta\xi'=\xi_0+\frac{\dot{\xi}}{k}\log\frac{\sigma_0-\dot{\xi}\zeta}{-\dot{\xi}\zeta}$$

not work

$$\Delta w_1=\int_0^{\xi_0}\sigma_1 d\xi-\int_0^{\xi_0}\sigma_2 d\xi$$

$$=\int_0^{\xi_0}(a\xi+b\xi^2)d\xi-\int_{\xi_1}^{\xi_0}\{(\sigma_0-\dot{\xi}\zeta)e^{-\frac{k}{\dot{\xi}}(\xi-\xi_0)}+\dot{\xi}\zeta\}d\xi$$

$$=a\frac{\xi_0^2}{2}+b\frac{\xi_0^3}{3}-\left[(\dot{\xi}\zeta-\sigma_0)\frac{\dot{\xi}}{k}e^{-\frac{k}{\dot{\xi}}(\xi-\xi_0)}+\dot{\xi}\zeta\xi\right]_{\xi_1}^{\xi_0}$$

$$=\frac{a}{2}\xi_0^2+\frac{b}{3}\xi_0^3-(\dot{\xi}\zeta-\sigma_0)\frac{\dot{\xi}}{k}+(\dot{\xi}\zeta-\sigma_0)\frac{\dot{\xi}}{k}e^{-\frac{k}{\dot{\xi}}(\xi'-\xi_0)}-\dot{\xi}\zeta\xi_0+\dot{\xi}\zeta\xi'$$

$\therefore$ total work $W\cong\sum\Delta w_1$

We can compare the strength of leathers by the total work.

(4) Experiment. in the case, $n=1$.

We take the following test pieces.

(No. 1) Rollor skin, the leather for picking, length 100mm, width 15mm, thickness 1.9mm, cross sectional area 28.5mm^2

The following results were shown the deta repeated tensile testing in load and unloading next.

stress	elongation	permanent elongation	elastic elongation
kg/mm^2	%	%	%
0.397	17	14.5	2.5
0.795	22.5	18.5	4.0
1.191	35.5	28.0	5.5
1.588	42.0	34.5	7.5
1.985	50.0	41.0	9.5
2.382	58.0	45.0	13.0
2.721	78.5	cutting	

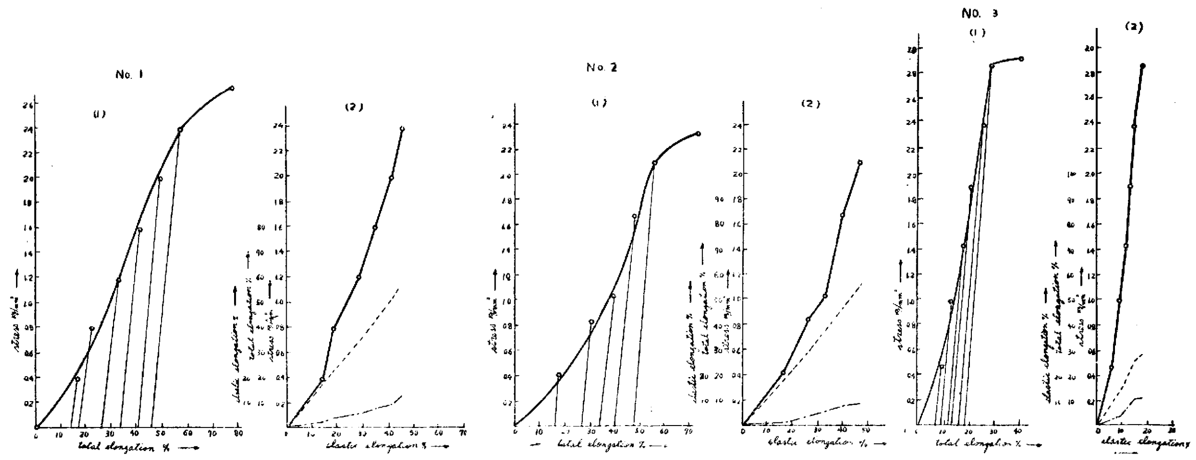

Fig. 2

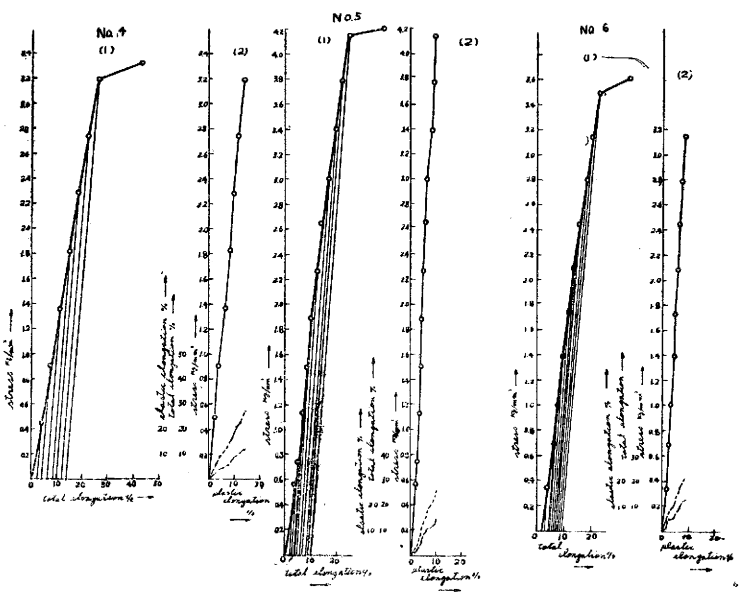

Fig. 3

(No. 2) Rollor skin, the leather for picking, length 100mm, width 15mm, thickness 1.8mm, cross sectional area 27mm^2,

stress	elongation	permanent elongation	elastic elongation
kg/mm^2	%	%	%
0.420	17.5	16	1.5
0.840	30.0	26	4.0
1.260	39.0	33	6.0
1.680	48.0	40	8.0
2.100	56.0	47	9.0
2,350	73.0	cutting	

(No. 3) Roller skin, the leather for picking, length 100mm, width 17mm, cross sectional area 23.8mm².

stress	elongation	permanent elongation	elastic elongation
kg/mm²	%	%	%
0.476	9	6	3.0
0.952	13	9	4.0
1.428	18	11.5	6.5
1.904	21.5	13.0	8.5
2.380	26	15.0	11.0
2.856	29	18.0	11.0
2.915	41	cutting	

(No. 4) Belt skin the leather for picking, length 100mm, width 16mm, thickness 3.1mm, cross sectional area 49.6mm².

stress	elongation	permanent elongation	elastic elongation
kg/mm²	%	%	%
0.457	4.5	2.5	2.0
0.914	8	4	4.0
1.371	12	7	5.0
1.828	16	9	7.0
2.285	19.5	10.5	9.0
2.742	23	12.5	10.5
3.199	27	14.5	12.5
3.336	43.5	cutting	

(No. 5) Belt skin, the leather for picking, length 100mm, width 19mm, thickness 3.4mm, cross sectional area 64.6mm²,

stress	elongation	permanent elongation	elastic elongation
kg/mm²	%	%	%
0.378	4	2.5	1.5
0.756	5.5	3.0	2.5
1.134	7.5	4.0	3.5
1.512	9.5	4.3	5.2
1.890	12.0	5.0	7.0
2.268	13.5	5.3	8.2
2.646	15.5	6.5	9.0
3.024	18.0	7.0	11.0
3.402	20.5	9.0	11.5
3.780	23.0	10.0	13.0
4.158	25.5	10.5	15.0
4.220	39.5	cutting	

(No. 6) Belt skin, the leather for picking, length 100mm, width 19mm, thickness 3.4mm, cross sectional area 64.60mm².

stress	elongation	permanent elongation	elastic elongation
kg/mm²	%	%	%
0.351	4	2.0	2.0
0.702	7	2.2	4.8
1.053	8.5	3.5	5.0
1.404	10.5	5.0	5.5
1.755	13.0	5.5	7.5
2.106	15.0	6.5	8.5
2.457	17.0	7.0	10.0
2.808	20.0	8.0	12.0
3.159	22.0	9.5	12.5
3.510	25.0	cutting	

3 Conclusion,

The experimental results of the stress-strain curve of leathres under the chemical treatments are showed in figures.

Those results are made under the constant pulling speed, $\dot{\xi}$ constant, approximately.

The stress-strain curves for test pieces of No. 1, No. 2, and No. 3 show concave curves but stress-strain curve for test pieces of No. 4, No. 5, No. 6 show approximately straight lines, *i, e,* $n=1$ curve. We know that leather would breaked out at a point which strains would be increased suddenly, and we know that the strength for No. 1, No. 2 and No. 3 leather are layer than one for No. 4, No. 5 and No. 6 leathers, because the strength of leathers would be compared with each other by the energy of stress-strain diagrams.

シアナミド誘導体の液態アンモニアに対する溶解度

大 島 好 文

Solubility of the cyanamide derivatives in liquid Ammonia.

By Yoshibumi ŌSHIMA

No data being available for solubility of the cyanamide derivatives in liquid ammonia, so the solubility of melamine or dicyandiamide in liquid ammonia was measured at a constant temperature below 30°C in thermostat using specially designed glass pressure bottle.

The solubility of purified melamine (m. p. 352°C) or purified dicyandiamide (m. p. 207°C) in liquid ammonia at 10°C or 20°C was measured. The results were as follows ; —

solvent / sample \ temp	Soluble amount in 100g liquid ammonia	
	10°C t 0.3°C	20°C t 0.5°C
Dicyandiamide	104.43 gr	117.46 gr
Melanine	4.16 gr	3.80 gr

緒　　言

有機化合物の液態アンモニア（以下液安と称す）に対する溶解度を測定した文献は少く，ヂシアンヂアミド及びメラミンに就ても文献が見当らない。著者は液安加圧下に於てヂシアンヂアミドを高温に加熱しメラミンを合成する場合[(1)]オートクレーヴ内に於るヂシアンヂアミドが反応前に液安と共存して如何なる状態にあるか，又反応後に生成メラミンが液安に溶解しているか否かを推定する資料にするためと，広く化学操作に寄与する目的とを以てヂシアンヂアミド及びメラミンの液安に対する溶解度を測定したので玆に報告する。

實驗裝置及び操作

本実験に使用した装置は普通の恒温槽，標準の液安蒸溜装置並に第1図の如き〔A〕,〔B〕2種のガラス製耐圧容器である。このガラス製耐圧容器の接続部には軟鋼又はヂュラルミン製のヂョイントを附属せしめる。使用に際してはコックの開閉が自在である如く工夫された真鍮製のコック押へを以てコックの部を締め，内圧によりコックの飛ぶのを防ぎ，予め15気圧までの耐圧試験を実施する。

ヂシアンヂアミド及びメラミンに就て以下に述べる操作を全く同様に行つた。即ち内容約 60ccのガラスフイルター付