

#000003\* JICST COPYRIGHT

CN 90A0269406, K90060800

Literature 29

TI 廃業した廃油再生設備の地下での地下水汚染の除去

ET Removal of the groundwater pollution  
below an abandoned waste oil  
refinery.

AU RIPPER P, FRUECHTENICHT H (Dr Trischler  
and Partner, Darmstadt, DEU)

JN A0070A (WSTED) (0273-1223) Water Sci Technol

VN VOL. 21, NO. 12 PAGE. 1841-1844 1989

CI (A) (al) (EN) (GBR) (写真5)

AB HanauのPintsch地点では1984年まで廃油の再生が行なわれていた。  
。同地の地下水の油汚染が発覚したので、地下水処理プラントを建設した。地下水  
の汲上げ、油水分離、エアストリッピング、凝集沈殿、活性炭ろ過を組合わせた。  
脂肪族塩素化合物、芳香族炭化水素はエアストリッピングで除去される。処理水は  
河川放流か地下へ再注入している

CC YEO1030Y (662:628.2/.3)

KW 地下水汚濁; 廃油; 下水処理施設; 復旧; 油水分離; 凝集処理; 活性炭処理; 脂肪  
族塩素化合物; ストリッピング; 芳香族炭化水素; 地下水; 化学工場

#000026\* JICST COPYRIGHT

CN 90A0138768, A90162002, K90080427

Literature 30

TI 北海における1987年Forties原油試験結果

ET Results of the 1987 forties crude oil trial in the North Sea.

AU HURFORD N, BUCHANAN I (Warren Spring Lab., Hertfordshire, GBR)

JN T0573A Proc Oil Spill Conf

VN VOL. 1989 PAGE. 525-532 1989

CI (C) (a1) (EN) (USA) (写真9, 表8, 参12)

AB 流出した原油の挙動を知るため, 1987年7月, 52° 10', 02° 23E地点から20tのForties原油を流し, その後40日間にわたり, 油層の移動, 拡散状態を追跡した。また一定時間間隔で油層試料を採取し, 油の物性変化を調べた。風速5~10m下にもかかわらず72時間後, かなりの量が海上面を浮遊した。最初の24時間で75%の原油が分散された。蒸散と浮化により物性が変化した。これら結果を各種モデル予測と比べた

CC SB02040B (614.777(26))

KW 海洋汚濁; 油汚染; 原油; 油漏れ; 拡散; 移流; 空中探査; 気象条件; 流跡線; 分散度; 北海

13)

Literature 31

#000002\* JICST COPYRIGHT

CN 86A0069851, A88042249, C86052079, K86020409

TI バーレーン, RA' S Abu Jarjurの46,000m<sup>3</sup>/day逆浸透  
プラントの建設と運転

ET Construction and operation of 46,000  
m<sup>3</sup>/day reverse osmosis desalination  
plant, Ra's Abu Jarjur, Bahrain.

AU AL-ARRAYEDH M (Water Supply Directorat  
e Ministry of Works Power and Water,  
Bahrain); ERICSSON B (SWECO, Stockholm);  
OHTANI M (Sasakura Engineering Co. Ltd  
., Osaka)

JN B0934A (DSLNA) (0011-9164) Desalination

VN VOL. 55 PAGE. 319 - 342 1985

CI (A) (d3) (EN) (NLD) (写図5, 表5)

AB このプラントはバーレーン政府が水需要に対応するために建設したものでささ倉機  
械(株)と住友商事(株)との協力によって'84年10月に完成した。このプラ  
ントは原水として高塩濃度の地下水を用いているが海水脱塩用の膜を用いているプ  
ラントとしては世界最大規模である。30日間の信頼性テストの結果と最適運転方  
法の検討結果を示した

CC SC02030T, XD02120Z (628.181, 66.06/.07:532.71)

KW バーレーン; 逆浸透; 脱塩装置; 工場建設; 運転試験; 地下水; 半透膜; プライン

<DIALOG File 8: >

00451920 E.I. Monthly No: E17505035098 E.I. Yearly No: E175082713

Title: *CRUDE OIL SPILLS: DISAPPEARANCE OF AROMATIC AND ALIPHATIC COMPONENTS FROM SMALL SEA-SURFACE SLICKS.*

Author: Harrison, Wyman; Winnik, Mitchell A.; Kwong, Paul T. Y.; Mackay, Donald  
Corporate Source: Argonne Natl Lab, Ill

Source: Environmental Science and Technology v 9 n 3 Mar 1975 p 231-234

Publication Year: 1975

CODEN: ESTHAG ISSN: 0013-936X

Language: ENGLISH

Journal Announcement: 7505

Abstract: Experimental data are presented for the weathering of five small (1.04 m\*\*3) ocean spills of South Louisiana crude oil. The oil was spiked with cumene and the concentrations of cumene and several alkanes were measured for up to 5 hr after the spill. An approximate model of the evaporation-dissolution process is derived which suggests that cumene is lost principally by evaporation. The effects of whitecapping and the existence of different weathering rates in the same spill are described. 13 refs.

Descriptors: \*WATER POLLUTION--\*Oil Spills; SEAWATER--Analysis; PARAFINS

Identifiers: CUMENE

Classification Codes: 453 .(Water Pollution); 471 .(Marine Science & Oceanography); 803 .(Chemical Agents & Basic Industrial Chemicals); 804 .(Chemical Products)

45 .(POLLUTION & SANITARY ENGINEERING); 47 .(OCEAN TECHNOLOGY); 80 .(CHEMICAL ENGINEERING)

<DIALOG File 6: (COPR. 1992 NTIS)>

1087240 NTIS Accession Number: PB84-238328

→ *Developing Methods for Analyzing Oil Dispersants in Seawater*  
(Final rept. Apr 80-Apr 82)

Haynes, D. L. ; Kelly, D. G. ; Smith, J. H. ; Fernandez, E. L.  
SRI International, Menlo Park, CA.

Corp. Source Codes: 055876000

Sponsor: Municipal Environmental Research Lab., Cincinnati, OH.

Report No.: EPA/600/2-84/144

Aug 84 36p

Languages: English

Journal Announcement: GRA18425

NTIS Prices: PC A03/MF A01

Country of Publication: United States

Contract No.: EPA-R-807059

An analytical method was sought for determining the concentrations of dispersants in seawater contaminated with oil in both field and laboratory situations. Methods of analysis for surfactants found in the literature included spectrophotometry, gas chromatography (GC), thin-layer chromatography (TLC), and high performance liquid chromatography (HPLC). References to collection, concentration, and cleanup methods included liquid/liquid extractions, gas stripping, and solid sorbents. Of seven

dispersants tested, one contained solely anionic surfactants, three contained only nonionic, and three contained both anionic and nonionic surfactants. HPLC normal phase, reverse phase, and ion exchange column techniques were tried. Detection methods included (1) direct measurement of the surfactants by tensammetry and ultraviolet (UV) spectrometry, and (2) derivation of the surfactant with phenyl isocyanate with subsequent measurement by UV spectrometry. The most promising method of those tested was analysis of the phenyl isocyanate derivative of POE nonylphenol by normal phase HPLC using UV spectrometric detection. A method of collection, concentration, and cleanup of seawater solutions of dispersants containing oil was developed using the solid sorbent SEP-PAK C18 cartridge. This sorbent successfully removed compounds that interfered with colorimetric tests.

Descriptors: \*Water analysis; \*Dispersants; \*Sea water; \*Surfactants; Gas chromatography; Thin layer chromatography; Ultraviolet spectroscopy; Ion exchanging; Water pollution; Chemical analysis

Identifiers: \*Oil pollution detection; \*Water pollution detection; High performance liquid chromatography; NTISEPAORD

Section Headings: 7D (Chemistry--Physical Chemistry); 68D\* (Environmental Pollution and Control--Water Pollution and Control); 99A\* (Chemistry--Analytical Chemistry)

#000012\* JICST COPYRIGHT

CN 86A0007893, C86012477, G86012000

TI 海上での油水分離

ET Separating oil from water offshore.

AU DELAINE J (John Delaine &amp; Co., UK)

JN D0791A (CMERA) (0302-0797) Chem Eng (London)

VN NO. 419 PAGE. 31-34 1985

CI (A) (b2) (EN) (GBR) (写図8, 表1)

AB 海上採油の際の排水の油水分離技術を展望。40mg/lの油の含有が許容されているが、より低水準であることが望まれる。場所の制約があるため、コンパクトな機械が必要。板状分離装置、粒状ろ材を用いたろ過、気ほうによる浮上分離、金網や多孔性セラミックおよびプラスチックを用いた凝集装置などの特性と応用を概観

CC XE03000E, UA10010K (66:541.18/.2, 622.276.01)

KW 海上採油; 廃水処理; 油水分離; 砂ろ過; 浮上法; 凝集処理; 邪魔板; コアレッセ  
ンス; 油水分離装置

K90110315

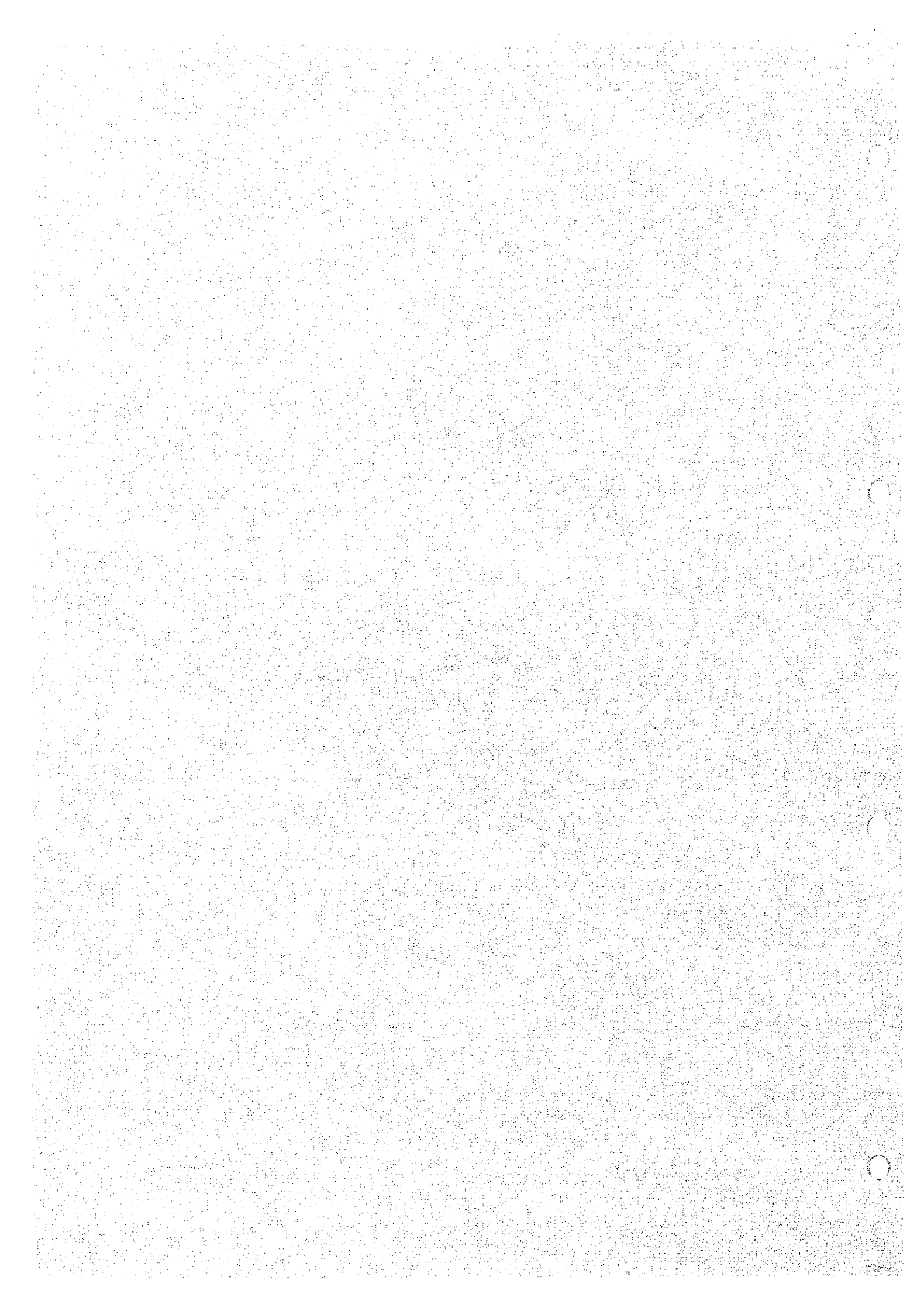
- TI Cabo Pilar号座礁および油流出  
ET The Cabo Pilar grounding and oil spill.  
AU PIZARRO F  
JN T0573A Proc Oil Spill Conf  
VN VOL. 1989 PAGE. 61-64 1989  
CI (C) (a1) (EN) (USA) (写真3, 参3)  
AB 1987年10月にマゼラン海峡で座礁したタンカーからの油流出について解説した。特に、油によって影響を受けた地域、分散剤の散布の様相、回収浄化作業などについて述べ、さらに、それらの問題点、効果、そのコストについて解説した。装置のレンタル代、人件費、分散剤、船、浄化および環境調査に使われた全コストは400,000米ドルであった  
CC SB02040B, RA02040X (614.777(26), 614.8 OTHERS)  
KW 海洋汚濁; 油汚染; 原油タンカ; 海難; 流出油; チリ; 災害対策; 汚染防止; 分散剤; 油濁処理剤; 浄化; 環境インパクト; 環境被害; 経済計算; 座礁

LI ANSWER 4 OF 5 COPYRIGHT 1991 ACS  
AN CA80(18):99923q  
TI Oil separation by air bubbling method using high polymer coagulants.  
1  
AU Kondo, Goro; Asakura, Mitsuaki; Tanaka, Minoru  
CS Kobe Univ. Merc. Mar.  
LO Kobe, Japan  
SO Mizu Shori Gijutsu, 14(11), 1161-9  
SC 60-2 (Sewage and Wastes)  
SX 51, 37, 46  
DT J  
CO MSYGAO  
PY 1973  
LA Japan  
AN CA80(18):99923q  
AB Oil sepn. by aeration is markedly accelerated by the addn. of inorg. salts. This method is suitable for treating tanker waste water, e.g. sea water ballast, but aggregation is slow in fresh water, e.g. industrial wastes. The aggregation of fine oil droplets is accelerated by the addn. of trace amts. of high polymer coagulants at 1-2 ppm and pH 3-4. The tested coagulants are primarily acrylamide.





APPENDIX R2-6



APPENDIX R2-6

Supplementary Experiments  
of Coagulation-Filtration

October, 1991

Water Re-use Promotion Center,  
Japan

## 1. Forward

This paper summarizes fundamental research grasping the properties of oil in seawater to develop an oil removal technique.

This is so that a desalination plant can be operated trouble-free when assuming that oil mixed with seawater is introduced to an RO desalination plant.

## 2. Experimental Procedure

The condition under which oil intruded in seawater disperses but does not float or settle, (that is, becomes stabilized), is experimentally determined. Then the following items are measured: oil concentration, oil solubility (oil amount which passes through a filter under a certain condition), distribution of particle diameters and oil removal by some kinds of flocculant under the above condition.

## 3. Experimental Method

### 3.1 Test on the Intrusion of Oil into Seawater

This test is carried out to determine a stable condition where oil intruded into seawater is observed without any floatation or settlement, and to determine the concentration change of oil intruding into seawater with time by changing the mixing ratio of oil with seawater and the agitating conditions as shown in Table 1.

Table 1 Conditions for test on the intrusion of oil into seawater

Test No.	Seawater (ℓ)	Oil *2 (mℓ)	Agitating condition	Seawater mixed(ℓ)	Agitation (Hr)	Settling time(Hr)
(A)	1.5	10	M.S *3 1Hr	1.5	0.5	1,5,10 24
(B)	1.5	10	M.S 24Hr	1.5	0.5	1,2,4,6
(C)	1.0	20	M.X *4 15min	9	0.5	1,2,4,8 24,48, 70

Note: \*1; Seawater is collected from the Inland Sea of Japan and used after filtration with GFF (TOYO GA-200, pore diameter of 1  $\mu$ m).

\*2; Oil is a diesel oil (as for the composition, see attached sheet).

\*3; M.S; magnetic stirrer.

\*4; M.X; mixer.

### 3.2 Measurement of Oil Dissolved in Seawater

It is difficult to make clear whether oil dissolves in seawater or not, what the definition of the dissolution is and what the verifying method is. In this experiment seawater intruded by oil is filtered under certain conditions and oil in the filtered seawater is regarded as the dissolved oil.

Figure 3 shows the flow chart.

Note: Water for the test was planned to be used at stabilized oil concentration levels which were verified by the test on the intrusion of oil into seawater in subparagraph 3.1, but the preparation of oil contaminated seawater which has stabilized oil concentration was found to be difficult because some fluctuation occurs depending on the agitating condition and the settling time. Determination for oil concentration was to be made each time measurement was carried out.

### 3.3 Test on Removal of Oil by Addition of Flocculants

The test is carried out to verify whether or not oil dispersed in seawater can be coagulated and removed by some flocculants which are used for pretreatment in desalination plants.

Figure 4 shows the flow chart.

### 3.4 Measurement of Particle Diameters of stabilized Oil Dispersed in Seawater

The test water which was prepared by the conditions of (C) shown in Table 1 and settled for 2 hours and 70 hours is used to determine the distribution of particle diameters by taking photographs of 3 fields of view (magnification: 200) with an optical microscope and then by reading the particle diameters and numbers.

Figure 5 shows the flow chart.

## 4. Experimental Results

### 4.1 Test on the Intrusion of Oil into Seawater

The experimental results after oil intrusion into seawater is

shown in Table 2.

Table 2 Oil mixing test with seawater

Test No. Settling time (Hr)	(A) (mg/ℓ)	(B) (mg/ℓ)	(C) (mg/ℓ)
1	2.0	19.3	69.5
2		14.9	68.1
4		11.4	66.7
5	1.0		
6		8.3	
8			42.4
10	1.8		
24	1.2		14.9
48			8.0
70			6.1

#### 4.2 Measurement of Concentration of Oil in Seawater

The test water similar to the test No.(A), and the test water of No.(C) prepared in the test on the intrusion of oil into seawater were used for the experiment and the results are shown in Table 3.

Table 3 Measurement of concentration of oil dissolved in seawater

Test	Test water	Settling time (Hr)	Oil in Test water (mg/ℓ)	Oil in Filtered water (mg/ℓ)
①	Test No.(A)	After 1	7.5	0.4
②	Test No.(B)	After 2	7.4	0.3
③	Test No.(C)	After 70	6.1	0.2

#### 4.3 Test on Removal of Oil by Addition of Flocculants

The test results on oil removal by addition of 4 kinds of flocculants are shown in Table 4.

Table 4 oil removal by addition of flocculants

Name of flocculant	conc. (ppm)	pH	Oil conc. in Test water conc. (mg/l)	Oil conc, after treatment (mg/l)
Ferric chloride $FeCl_3$	5	7.0	Test No.(A); 1 Hr	0.5
	10		11~13	0.2
	50			0.5
	10		Test No.(C); 4 Hr 67	0.3
Aluminum sulfate $Al_2(SO_4)_3$	5	6.0	Test No.(A); 1 Hr	0.6
	10		11~13	0.5
	50			0.5
Poly-aluminum chloride PAC	5	Not adjust (7.5)	Test No.(A); 1 Hr	0.4
	10		11~13	0.5
	50			0.5
Hydroxyethyl cellulose	2		Test No.(A); 1 Hr	0.7
	5		11~13	0.5
	10			0.8



#### 4.4 Measurement of Particle Diameters of Stabilized Oil Dispersed in Seawater

Photographed results with an optical microscope are shown in Photograph 1 and 2 for the test water prepared under the condition in test (C) after the test water had settled for 2 hours and 70 hours and the measured results of distribution of particle diameters of oil, based on these photos, are shown in Table 5.

Table 5 Distribution of Particle Diameters of Oil

Range of particle diameter ( $\mu$ )	After 2 Hr Settling		After 70 Hr Settling	
	Number	Distri. rate (%)	Number	Distri. rate (%)
1 ~ 2	303	39.6	112	59.6
2 ~ 3	212	27.7	38	20.1
3 ~ 4	108	14.1	24	12.8
4 ~ 5	55	7.2	3	1.6
5 ~ 6	31	4.1	7	3.7
6 ~ 7	18	2.3	3	1.6
7 ~ 8	12	1.6	1	0.6
8 ~ 9	5	0.6		
9 ~ 10	5	0.6		
10 ~ 11	6	0.8		
11 ~ 12	2	0.3		
12 ~ 13	1	0.1		
13 ~ 14	4	0.5		
14 ~ 15	0	0		
15 ~ 16	0	0		
16 ~ 17	2	0.3		
17 ~ 18	1	0.1		
18 ~ 19	1	0.1		

Remarks: The distribution of particle diameters is shown by the mean value of the three attached photographs (3 fields of view).

## 5. Summary of Experimental Results and Discussion

The following is a summary of the experimental results:

### 5.1 Test on the Intrusion of Oil into Seawater

When oil intruded into seawater, it was verified that the intruded oil concentration varies depending on the mixing ratio of oil with seawater and the agitating condition, and furthermore, that the concentration of oil dispersed in seawater changes with settling time.

### 5.2 Measurement of Concentration of Oil Dissolved in Seawater

Test water samples were filtrated by TOYO Filter No.5C and a membrane filter having pores of  $0.45 \mu\text{m}$  in this test.

The test was carried out assuming that oil in filtered sea water is dissolved oil. As a result, it was found that oil of about  $0.2$  to  $0.4 \text{ mg}/\ell$  dissolves (passes through the filter).

### 5.3 Test on Removal of Oil by Addition of Flocculants

It was found that iron (III) chloride or ferric chloride, aluminum sulfate, and PAC have considerable flocculating effects and that the test water containing oil of  $10\text{-odd mg}/\ell$  could be lowered to that of  $0.5 \text{ mg}/\ell$  or less by the addition of each flocculant.

The removal rate relates to oil concentration to be treated and it could be confirmed that residual oil concentration could be altered to  $0.5 \text{ mg}/\ell$  or less when ferric chloride of  $10 \text{ ppm}$  was added to the test water containing oil of about  $70 \text{ mg}/\ell$ .

As for the hydroxyethyl cellulose, the removal rate was a little lower than that of the above mentioned three flocculants although there were some problems as to the applied method.

### 5.4 Measurement of Particle Diameters of Oil Stably Dispersed in Seawater

Oil containing water which was prepared by mixing was diluted and dispersed in seawater, and then settled for a certain time

(2 hours and 70 hours) to measure the particle diameters of oil dispersed in seawater with a microscope. As a result, it could be verified that almost all of the particle diameters were  $5\mu\text{m}$  or less.

The following conclusions were obtained:

The concentration of stabilized oil dispersed in seawater may depend on the kind of oil, the physical properties (specific gravity, viscosity), and water temperature.

Moreover, the following conditions are required to acquire stabilized conditions where oil mixed with and dispersed in seawater does not float or settle:

- 1) sufficient emulsification of oil, and
- 2) extended settling time

For these reasons, it is difficult to carry out many kinds of tests under fixed conditions (oil concentration) and it is thought better to carry out the test by using test water preparation of the C method, that is, by diluting highly concentrated oil emulsion with seawater in a large container by keeping it for a time, and taking out the test water from the lower part of the container and finally, by verifying oil concentration in each sample of water.

## 6. Summary

The preparation of test water containing oil, the measuring method for oil concentration, and the flocculation effect by addition of flocculants and filtration effects were verified by fundamental investigation in relation to the properties of oil in seawater carried out in this experiment.

It is thought necessary to further carry out practical model tests with sand filtration equipment and flocculants (which showed the effect in the fundamental experiments) to confirm changes of filtration performance when oil intrudes into the sand filtration equipment based on this fundamental experiments.

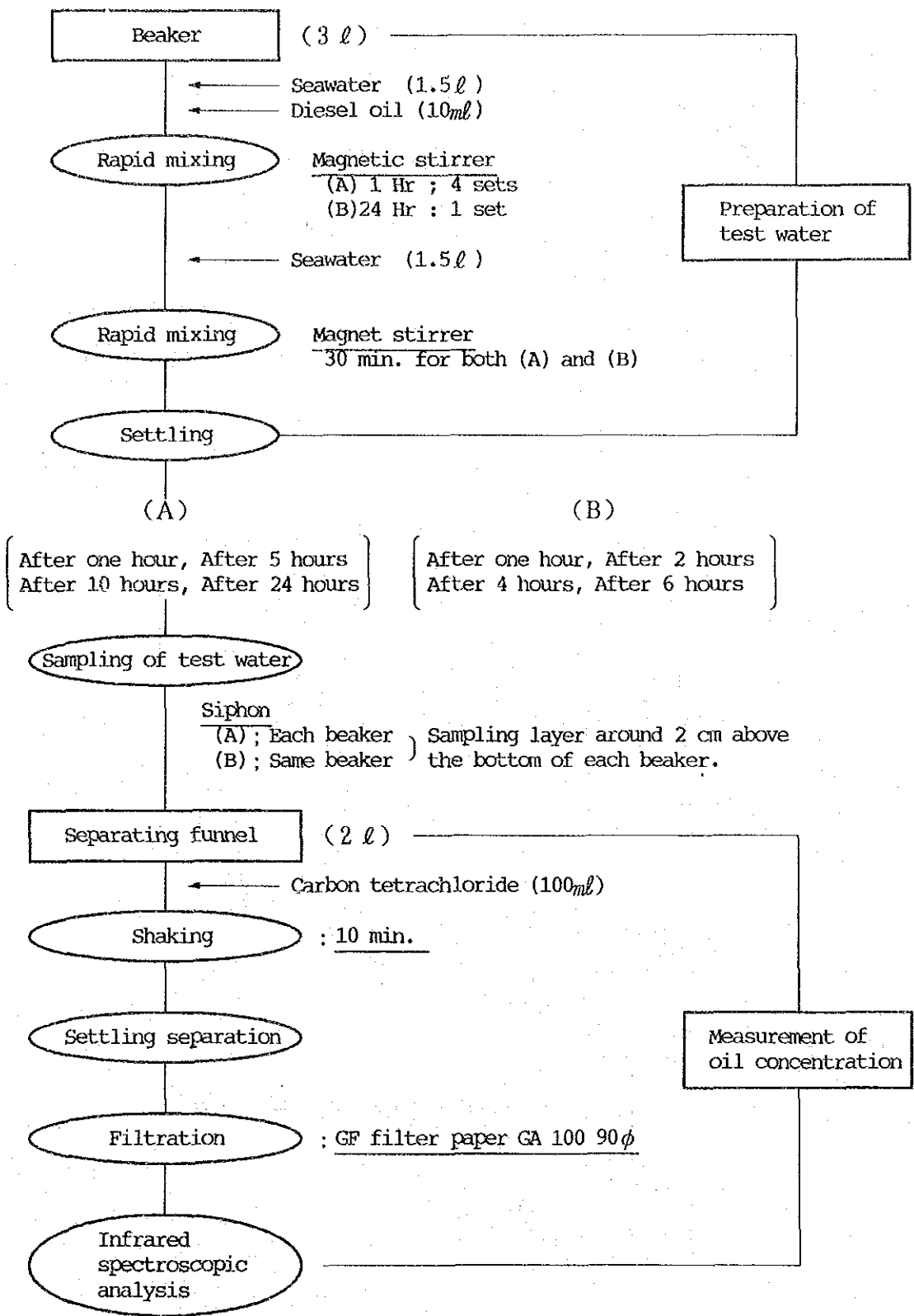


Fig.1 Flow chart for test on the intrusion of oil into seawater [Test Nos.(A) And (B)]

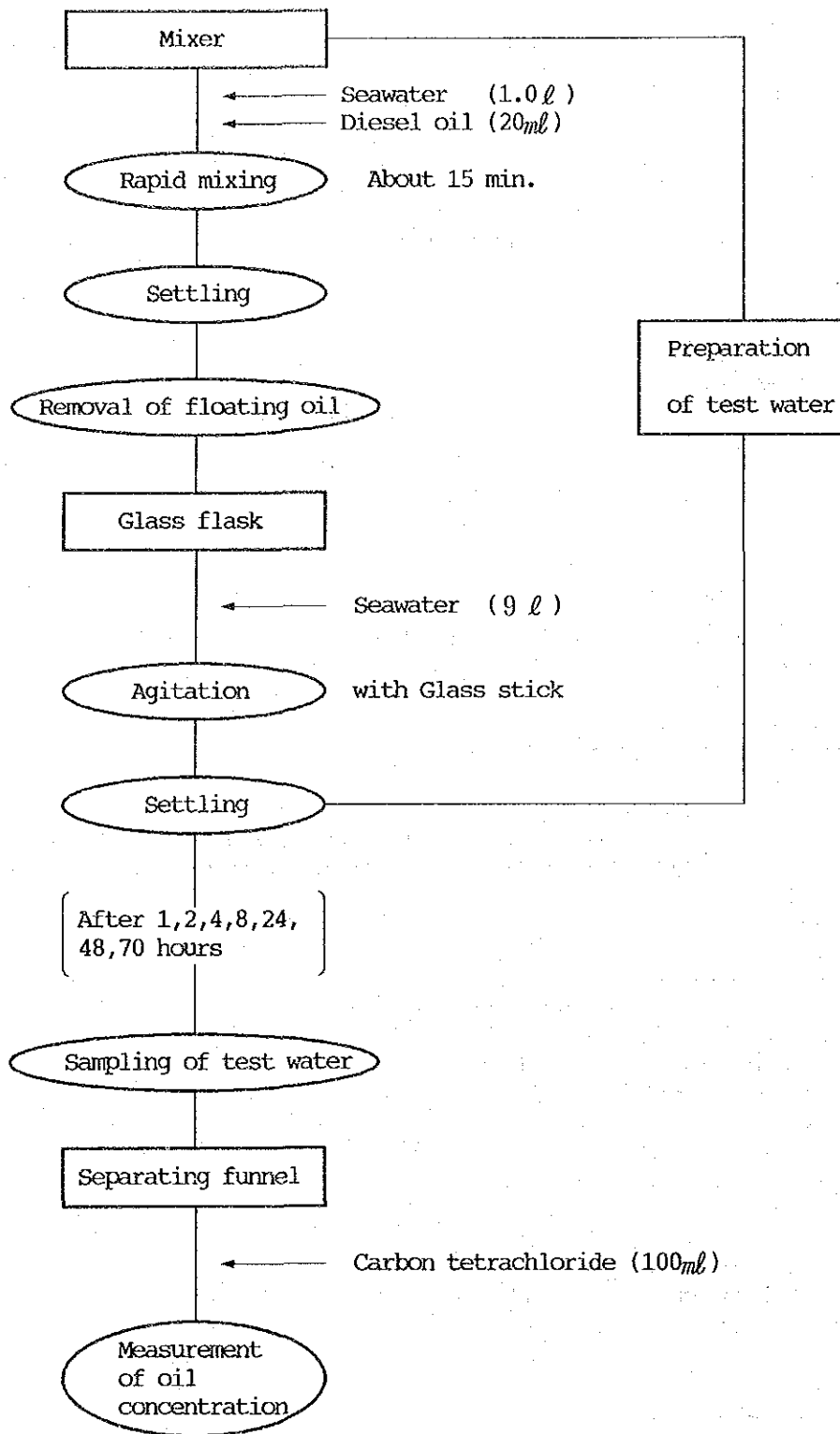


Fig.2 Flow chart for test on the intrusion of oil into seawater  
[Test No. (C)]

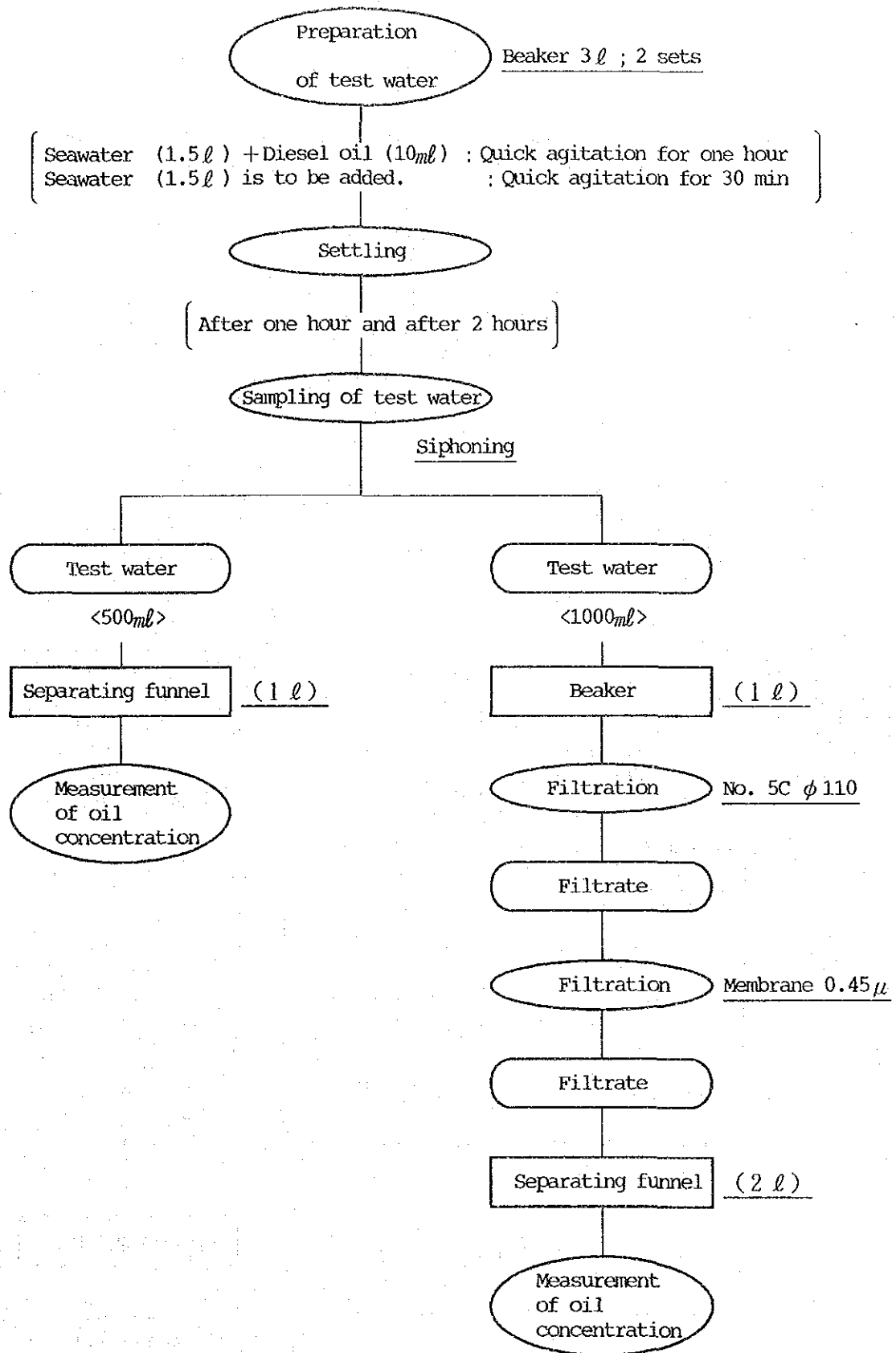


Fig.3 Flow chart for the measurement of oil in seawater

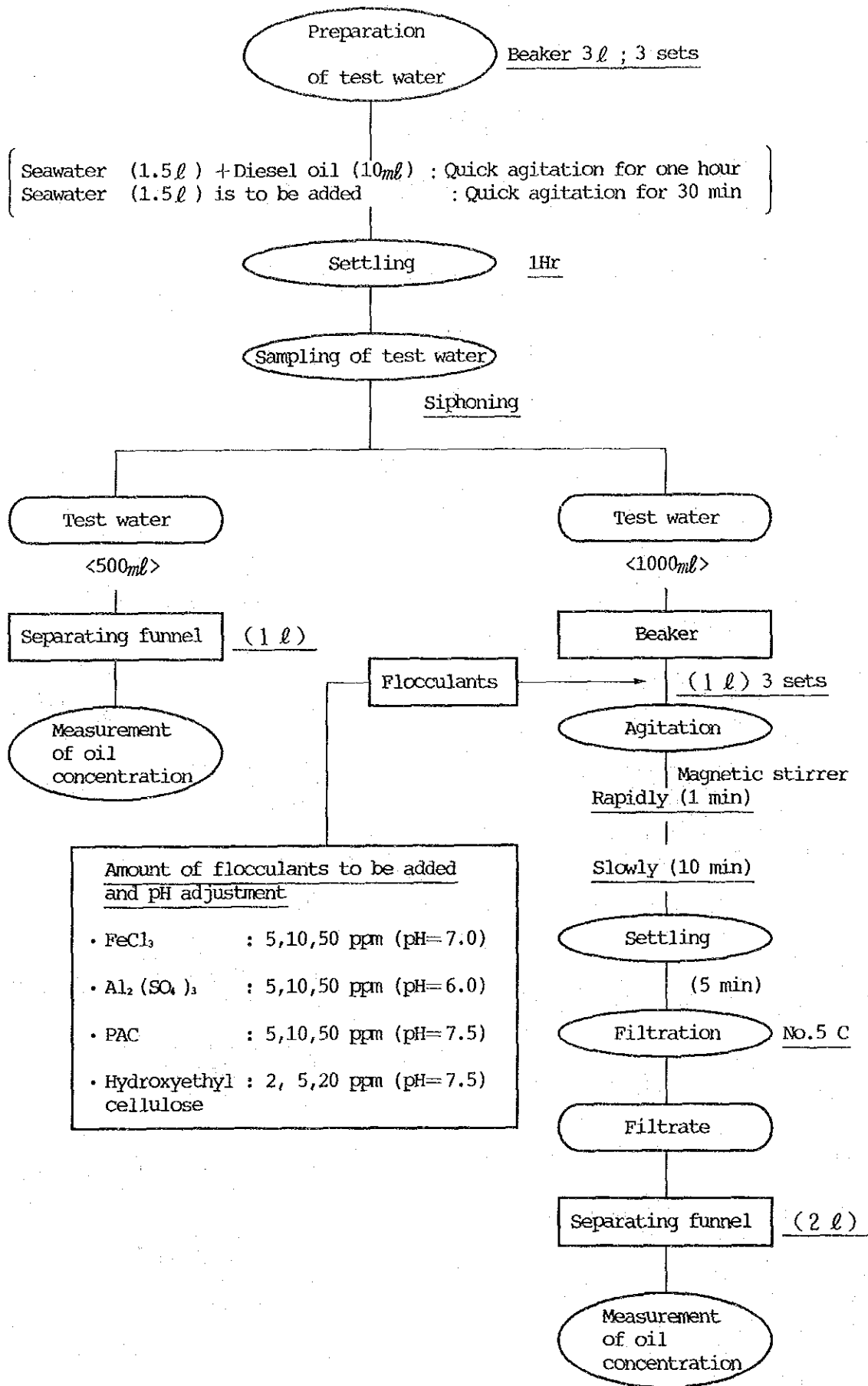


Fig.4 Flow chart for test on the removal of oil by the addition of flocculants

Preparation  
of test water

Test on the intrusion of oil into seawater

According to Test No. (C)

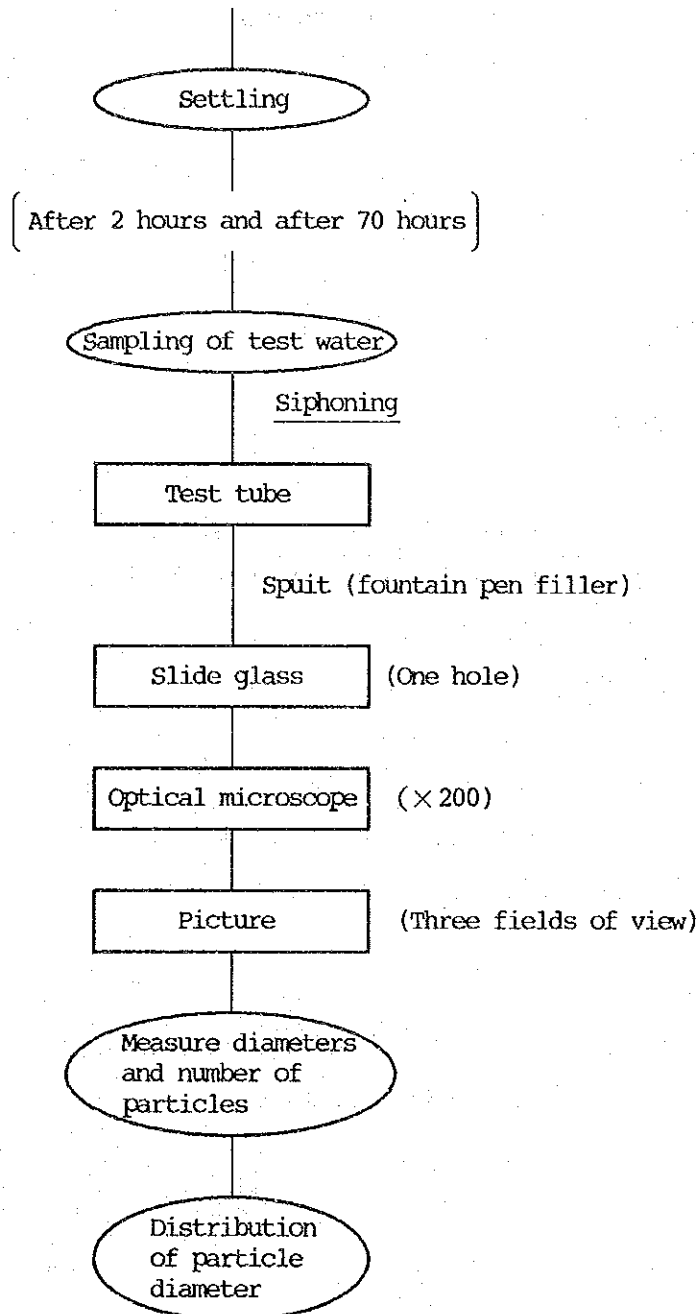


Fig.5 Flow chart for the measurement of particle diameters of stabilized oil dispersing in seawater



## Measurement of the Composition Ratio of each Carbon Number of Diesel Oil Used in This Experiment

### 1. Method

A sample was dissolved in carbon disulfide to prepare a 10% (v/v) solution of which  $1\mu\ell$  was injected into a gas chromatograph-mass spectrometer. The obtained chromatograph was classified into respective compounds having same carbon number on the assumption that n-alkane of hydrocarbons having a same carbon number elutes latest, to get the percentage of total peak area of each carbon number to the total peak area of chromatograph (except peak of carbon disulfide)

### 2. Equipment

GC analytical condition

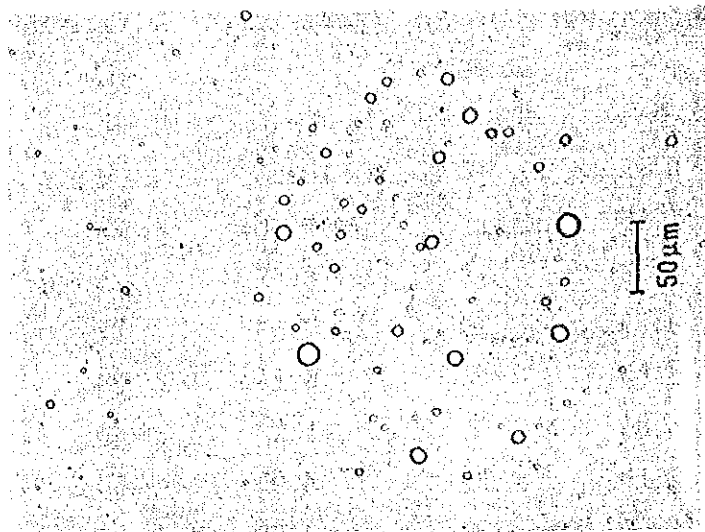
Instrument : Shimazu GC-14APF  
Column : Fused silica capillary column CBP-1,  
50mm $\times$ 0.2mm i.d., 0.25 $\mu$ m film thickness,  
Temperature : Column; 35°C (1.5min.) $\rightarrow$ 310°C, 5°C/min.  
Injector; 280°C, Detector; 310°C  
Carrier gas : Inlet press.; 2.0kg/cm<sup>2</sup>.  
Split : 1/50  
Detector : FID; Range 10<sup>2</sup>  
; Air 0.5kg/cm<sup>2</sup>, 400ml/min.  
; H<sub>2</sub> 0.5kg/cm<sup>2</sup>, 40ml/min.

### 3. Results

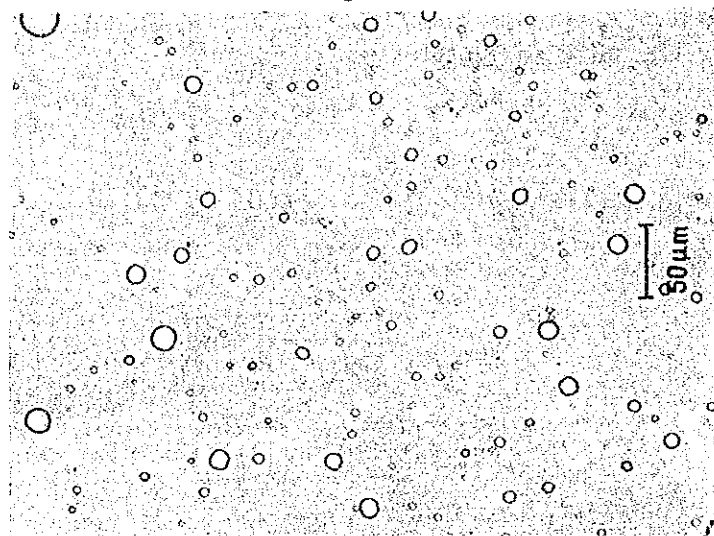
The composition ratio of each carbon number was shown in the following table. The unit is %.

Carbon number	Composition	Carbon number	Composition	Carbon number	Composition
8 or less	0.22	16	10.66	24	2.42
9	1.90	17	9.06	25	1.59
10	3.48	18	8.42	26	1.09
11	4.28	19	7.68	27	0.65
12	4.88	20	6.14	28	0.31
13	5.86	21	5.07	29	0.18
14	8.19	22	4.07	30	0.08
15	10.69	23	3.05	31 or more	0.02

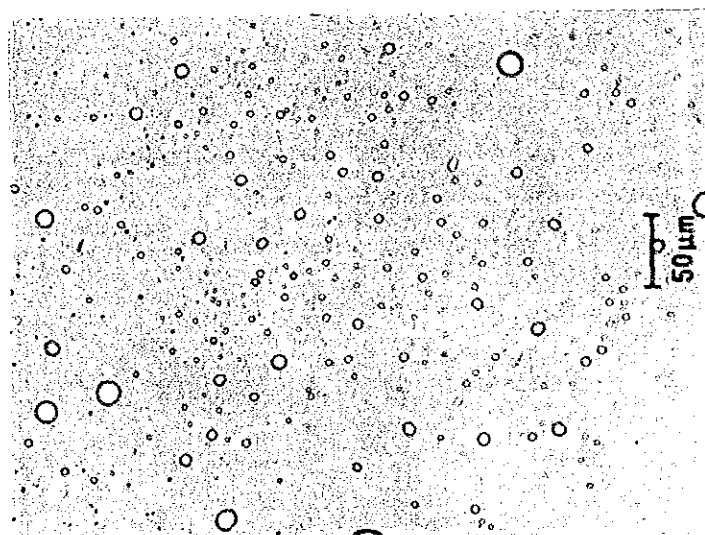
Refer to the chromatograph.



a) 2Hr Settling × 200

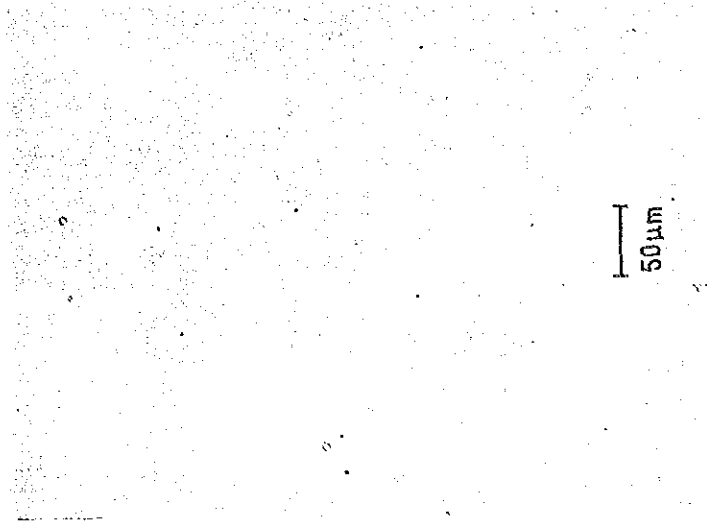


b) 2Hr Settling × 200

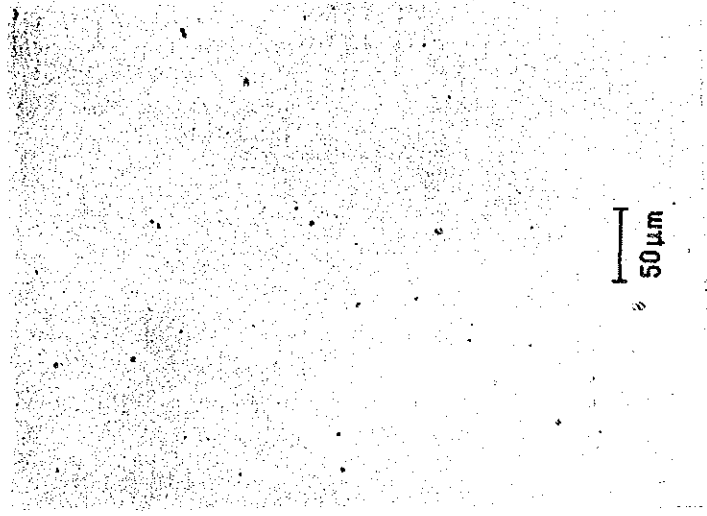


c) 2Hr Settling × 200

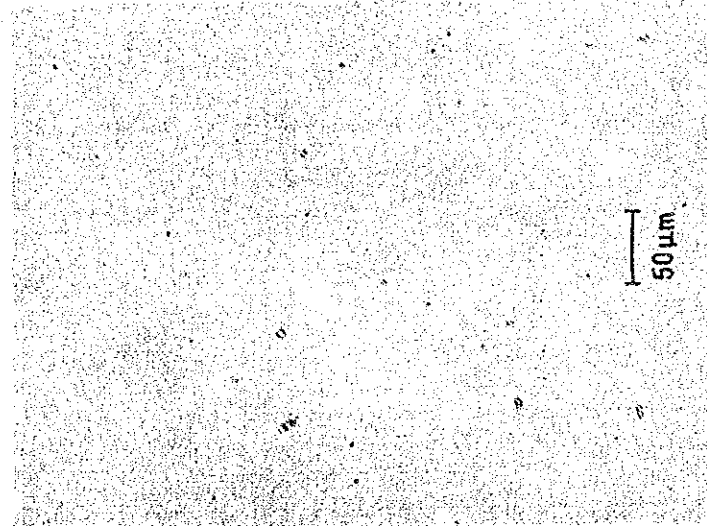
Photo. 1 Microscope Photo. for Measurement of Oil Particles in Seawater



d) 70Hr Settling × 200



e) 70Hr Settling × 200



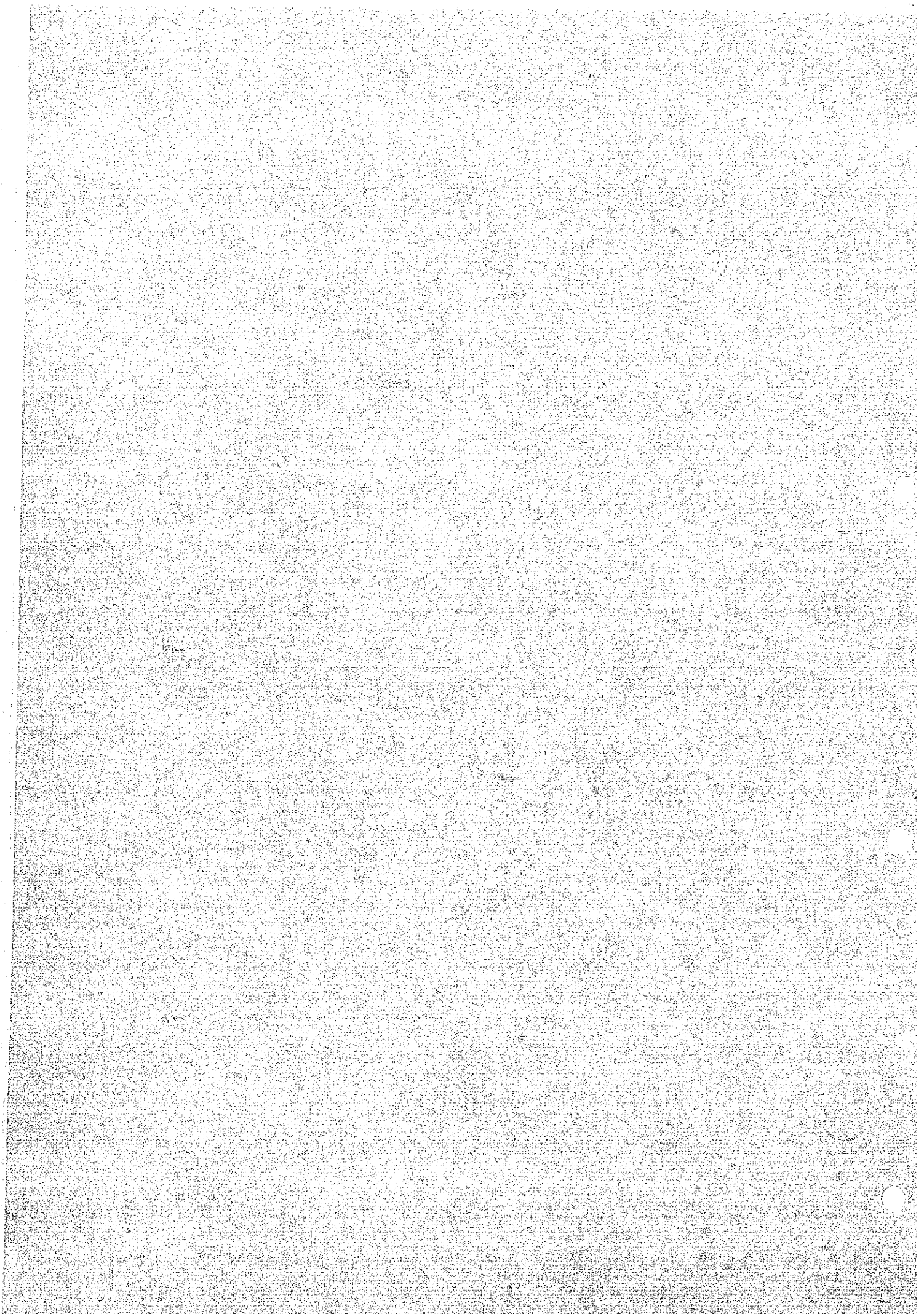
f) 70Hr Settling × 200

Photo. 2 Microscope Photo. for Measurement of Oil Particles in Seawater



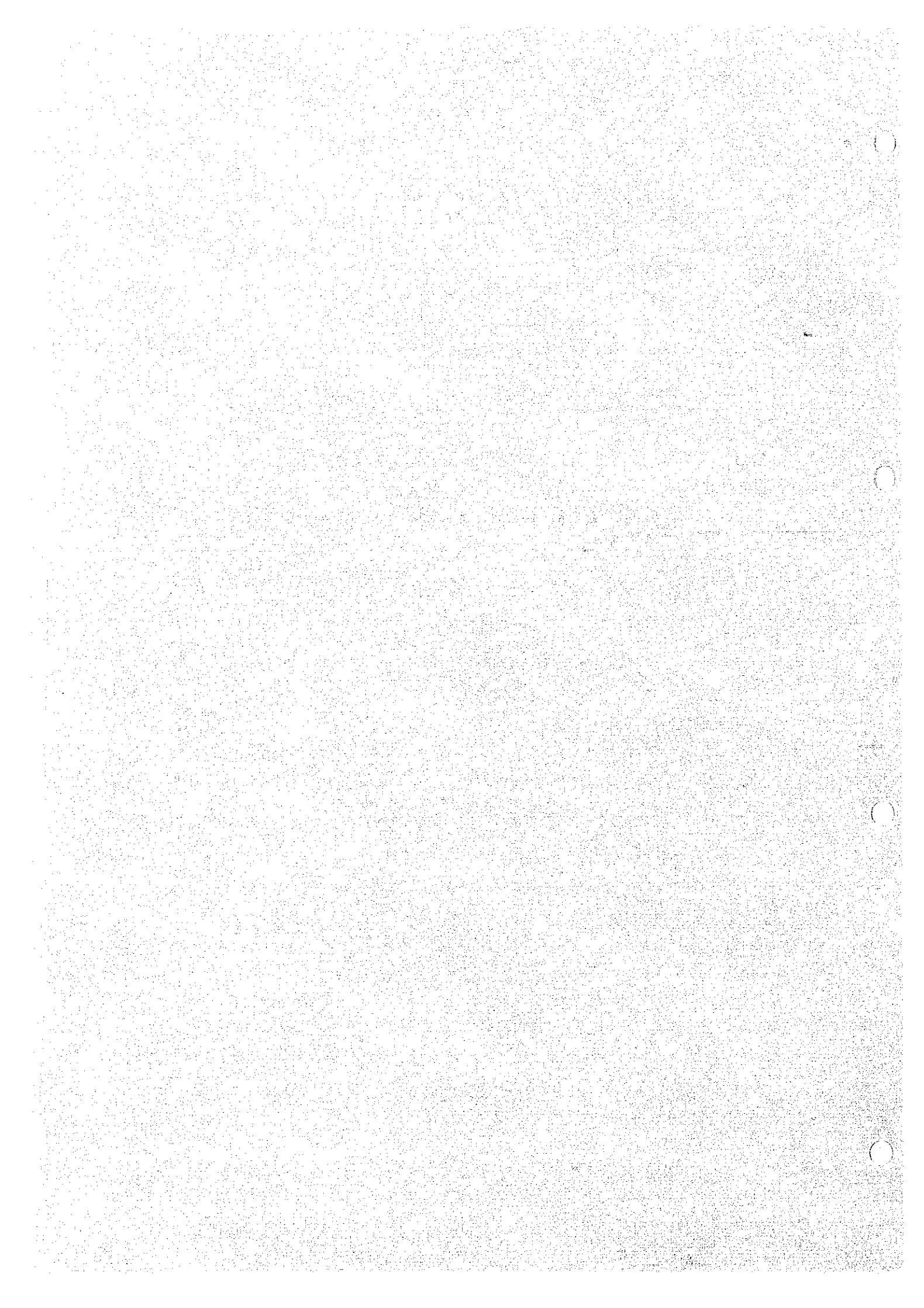
## 5. APPENDIX for R3 (Pollution Effect of Membrane Cleaning Discharge)

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APPENDIX R 3 - 1





APPENDIX R3-1 Literature Retrieval

1) DIALOG retrieving system

Retrieving process	Set number	Remarks
<p>? B411</p> <p>? S ((RO+REVERSE?( )OSMO?)*(SEA( )WATER+BRIN?)*            *(DE( )SALT?+DESALT?+PURIF?+RINS?+DRAIN?+            RELEAS?)*PY = 1976:1991</p>		<ul style="list-style-type: none"> <li>• Connect to DIALINDEX</li> <li>• Surveying numbers of papers in each file</li> <li>• Extracting papers about desalination of seawater after 1976</li> </ul>
<p>? SAVE TEMP</p> <p>Temp Search Save "TB014" stored</p>		<ul style="list-style-type: none"> <li>• Record the former retrieving expression</li> </ul>
<p>? B245, 117, 399, 28, 44, 8, 41, 6, 144, 96</p>		<ul style="list-style-type: none"> <li>• Connect to 10 files that have many papers</li> </ul>
<p>? EXS TB014</p>	S1 915	<ul style="list-style-type: none"> <li>• Operate the retrieving expression → 915 papers</li> </ul>
<p>? S S1 AND PY = 1981:1991</p> <p>? PR S2/5/ALL</p>	S2 579	<ul style="list-style-type: none"> <li>• Change surveying term to after 1981 → 579 papers</li> <li>• Request offline print of 579 papers</li> </ul>
<p>? B350, 351</p>		<ul style="list-style-type: none"> <li>• Connect to (WPI, WPIL)</li> <li>• Operate the retrieving expression → 213 papers</li> </ul>
<p>? EXS TB014</p> <p>? S S3 AND IC = B01D-013</p>	S3 213 S4 147	<ul style="list-style-type: none"> <li>• Select files by International Patent Classification</li> </ul>

Retrieving process	Set number	Remarks
? S S4 NOT (PC = SU AND NP = 001)  ? PR S5/7/ALL  ? LOGOFF	S5 146	<ul style="list-style-type: none"> <li>• Eliminate patents those applied for only in U.S.S.R.</li> <li>• Request offline print of 146 papers</li> </ul>

2) JOIS retrieving system

(1) S : 136, 393 タンスイカ&

U : ギャクシントウマク& OR ハントウマク&

(2) S : 2, 970 ギャクシントウマク&+ハントウマク&

U : センジョウ

(3) S : 32, 281 センジョウ

U : KW : ハイスイ (ハイシュツ)

(4) S : 8, 401 KW : ハイスイ (ハイシュツ)

U : DESALINAT&

(5) S : 723 DESALINAT&

U : SEMIPERMEABLE (1W) MEMBRANE?

(6) S : 34 SEMIPERMEABLE (1W) MEMBRANE?

U : CLEANING OR LINS

(7) S : 3, 268 CLEANING&LINS

U: RINSE?

(8) S: 119 RINSE?

U: DRAINAGE OR DRAINING

(9) S: 2, 766 DRAINAGE OR DRAINING

U: 1+5 タンスイカ

(10) S: 136, 608 1+5 タンスイカ

U: 2+6 ギャクシントウ

(11) S: 2, 976 2+6 ギャクシントウ

U: 3+7+8 センジョウ

(12) S: 34, 072 3+7+8 センジョウ

U: 4+9 FERE

(13) S: 10, 099 4+9 FERE

U: 11\*13\*12\*10

(14) S: 0 11\*13\*12\*10

U: 10\*11

(15) S: 521 10\*11

U: 15\*(12+13)

(16) S: 22 15\*(12+13)

U: ¥P A

<省略>

S: 出力終了しました (SSNo [16] から22件)

U: REVERSE (1W) OSMOSIS

(17) S: 803 REVERSE (1W) OSMOSIS

U: RO

(18) S: 2,703 RO

U: 17\*1

(19) S: 208 17\*1

U: 19\* (12+13)

(20) S: 5 19\* (12+13)

U: 18\*1

(21) S: 146 18\*1

U: 21\* (12+13)

(22) S: 5 21\* (12+13)

U: (20+22) #16

(23) S: 3 (20+22) #16

U: ¥P A

<省略>

S: 出力終わりました (SSNo {23} から3件)

U: ハイスイ

(24) S: 18,062 ハイスイ

U: 19+21+15

(25) S: 97 19+21+15

U : 25 \* (12 + 13 + 24)

(26) S : 9 25 \* (12 + 13 + 24)

U : ㄥP A

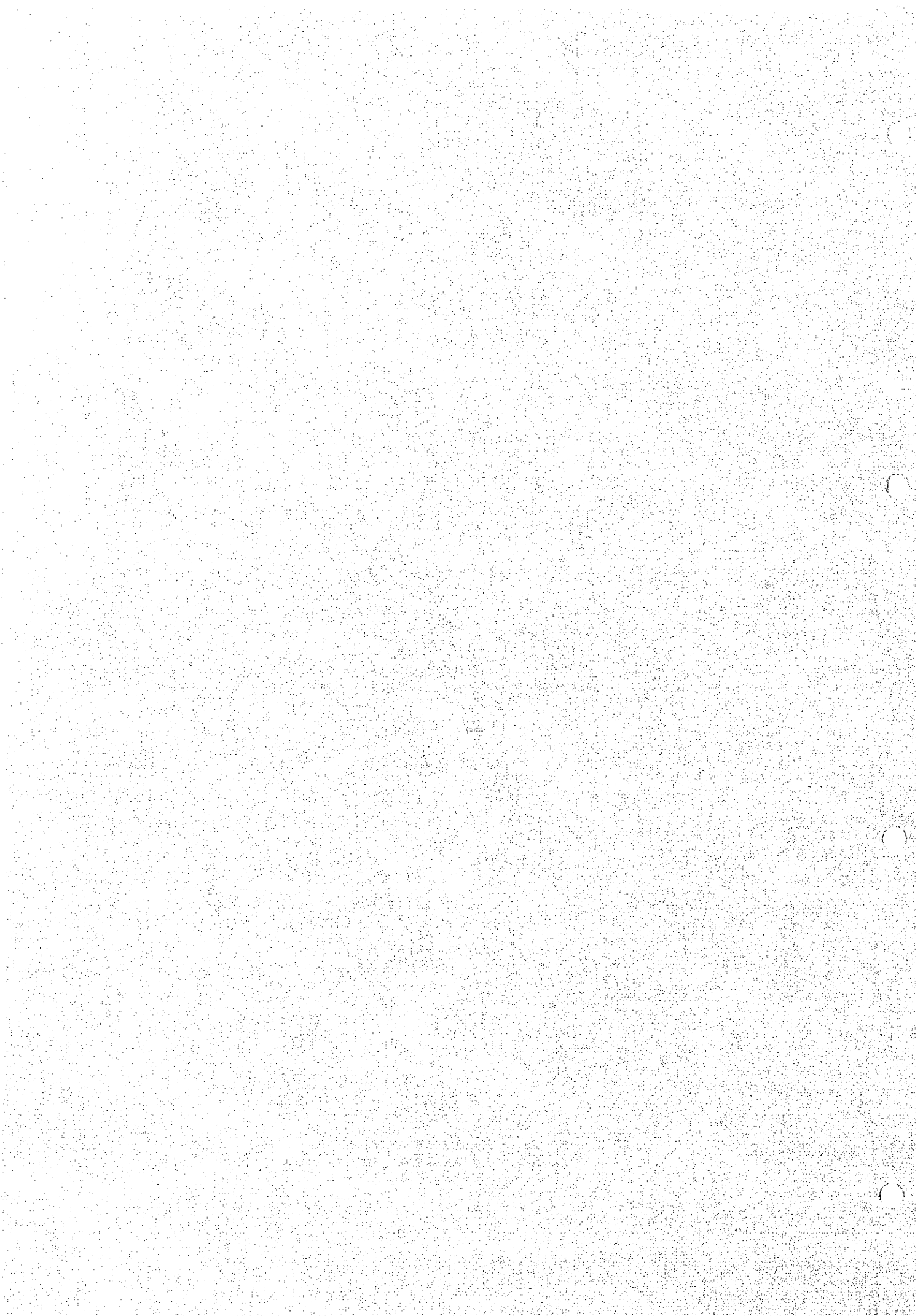
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S : 出力終了しました (SSNo (26) から9件)



APPENDIX R3 - 2





APPENDIX R3-2 Selected Paper by Analysis of the Original

File No.	Re. No.	Title ( Author )	Source
117 (010, 011)	1	Operating Experiences on a Reverse Osmosis Plant which Converts Sea Water into Boiled Feed Water (Vera I.)	Industrial Water Engineering Vol. 18, No. 16, 1981, P22-29
117 (NTIS 6)	2	Development of New Cleaning Techniques for Reverse Osmosis Membranes. (Jolaine A. Jonson and Thomas M. Leahy )	Available from the National Technical Service as PB83-146746 Append. OWRT C-80152-S(8519)(1) 14-34-0001-8519 30, Mar., 1982 183pp.
117 (96)	3	Solution of Contradictory Problem of Simultaneous Desalination and Concentration in Reverse Osmosis (C. A. Yagodin, et al.)	Desalination Vol. 46, 1983, p171-177
117 (96)	4	Development of an Improved Cleaning Solution for RO WPU Units (Clyde E. Milstead and Robert L. Riley)	Available from the National Technical Service as AD-A1196 Report No. SST-88-01 Department of the Army Contract DAA K-87-006 11, Apr. 1988 245pp.

File No.	Re. No.	Title ( Author )	Source
1 1 7 (28, 44)	5	High Recovery Reverse Osmosis (Bruce M. Watson)	Desalination Vol. 78, No. 1, 1990, p91-97
1 1 7 (44)	6	Reclaiming Reverse Osmosis Blowdown with Electrodialysis Reversal (Eugene R. Reahl)	Desalination Vol. 78, No. 1, 1990, p77-90
2 8 (44)	7	Pre-and Post-Treatment at the RO Plant at RA's Abu Jarjur, Bahrain (M. Al Arrayedhy)	Desalination Vol. 63, 1987, p81-94
2 8 (44)	8	Trace Metal Fouling and Cleaning of Sea- Water R.O. Membranes (G. Peplow, F. Vernon)	Desalination Vol. 66, 1987, p271-284
2 8 (117, 44)	9	Preface (O. K. Buros)	Desalination Vol. 78, 1990, p1-2
4 4	1 0	Energy recovery from the reject brine of Reverse Osmosis System (S. C. May et al.)	PBNo. 83-209031 Report No. W83-03113 Selected Water Resources Abstracts Mar. 1981, pp. 71

File No.	Re. No.	Title ( Author )	Source
4 4	1 1	Drinking Water from the Sea:Reverse Reverse Osmosis, the Modern Alternatine (J. T. Allanson and R. Charnley)	Trans. Inst. Mar. Eng. (TM) Vol. 95. No. 38, 1983 . pp. 13
4 4	1 2	Future for Desalination by Reverse Osmosis (M. A. Jaward)	Desalination Vol. 72. 1989, p23-28
0 1 0 0 1 1	1 3	Wastewater Treatment by ion-exchange- membren method (Y. Tanaka, S. Itoi)	P P M Vol. 7. No. 3, 1976 p41-52
0 1 0 0 1 1	1 4	Macromolecular Membrane Separation (K. Tanaka)	Chemical Equipment Vol. 32, No. 11, 1990 p88-99
0 1 0 0 1 1	1 5	Drinking Water from the Sea: Reverse Osmosis, in Ehime (F. Kawamata)	Ebara Infirco, Report No. 83, 1981 p44-49
0 1 0 0 1 1	1 6	Report of Desalination system in Nagasaki (J. Kijima, M. Kunitomo)	Water-Making Technology Vol. 8, No. 1, 1982 p39-43
0 1 0 0 1 1	1 7	High Frequency Excitation and Vibration Studies on Hyperfiltration Membranes (Cal. C. Hermann)	Desalination Vol. 42. 1982, p329-338

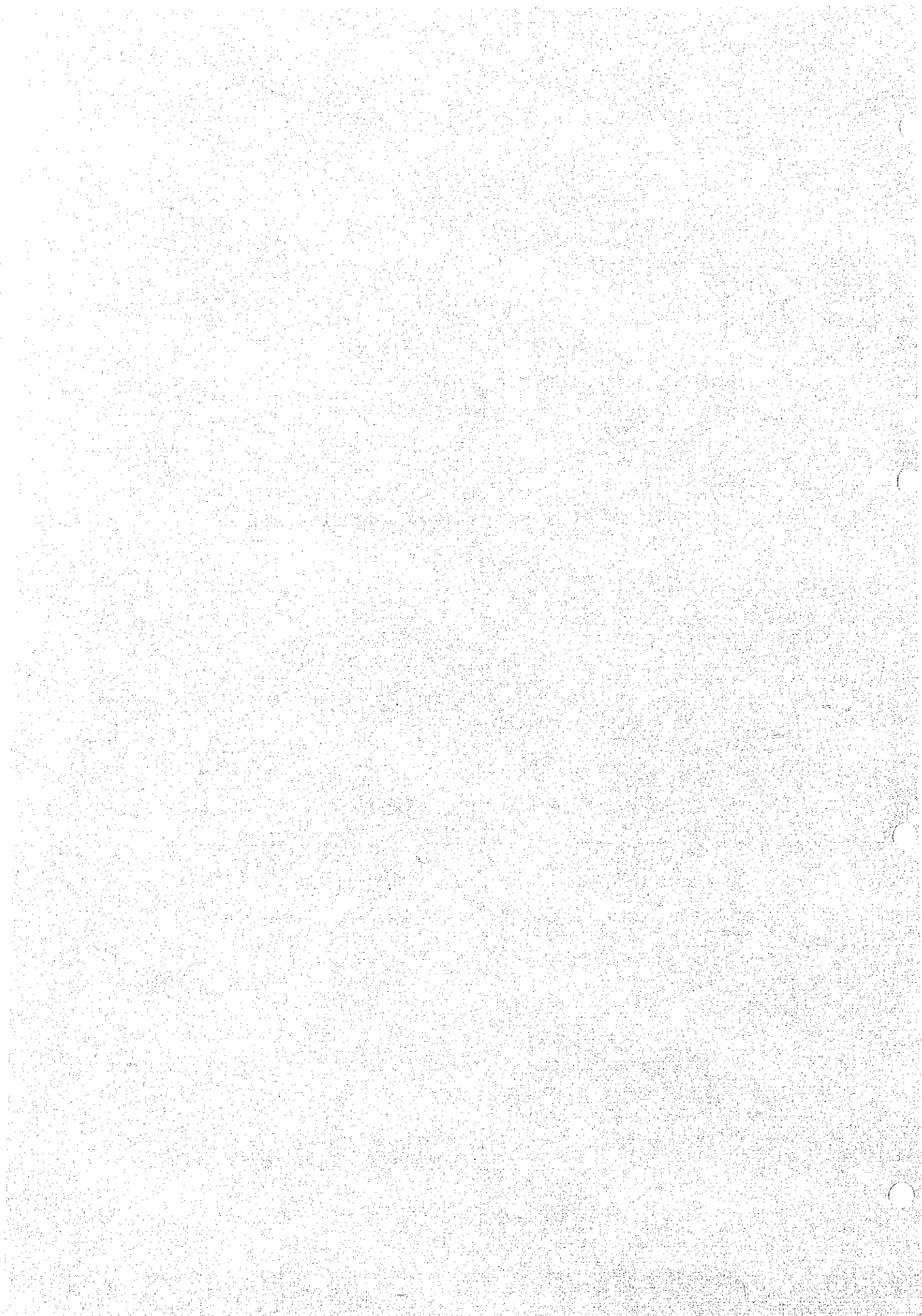
File No.	Re. No.	Title ( Author )	Source
010 011	18	Development of Improved Cleaning and Surface Regeneration Methods and Economic Analysis of These Methods for Seawater Membranes  (Buros and Roe Industrial Surv. Corp., New Jersey)	PB Rep. PB-81-170607, 1981 114pp
010 011	19	Recovery of Chemicals by Membrane Process  (Patric K. NG)	Tutorial Lectures In Electro-Chemical Eng. And Tech. - II Vol. 79, No. 229, 1983 p187-196
010 011	20	Design of Wastewater Treatment System (19)  (N. Mizorogi)	Water Vol. 25, No. 3, 1983 p36-40
010 011	21	Electrodialysis Reversal (EDR) for Surface and waste waters desalination  (J. W. Van Wely)	Technische Mitteilungen Vol. 78, No. 12, 1985 p255-269
010 011	22	Desalination And Reuse of Power Plant Effluents: From Pilot Plant to Full Scale Application	Desalination Vol. 67, No. 1/2/3, 1987, p255-269
010 011	23	Pilot Experiences on the Recovery of Polluted Reverse Osmosis Membranes  (M. Farinas, et al.)	Desalination Vol. 66, 1987, p385-402

File No.	Re. No.	Title ( Author )	Source
010 011	24	Graphic Evolution of the 24,000 Hours(3 Years) Operating Data of a Desalination Plant, in Las Palmas, Canary Islands, Spain (Enrique Ruiz Saavedra)	Desalination Vol. 76, NO. 1/3, 1989, p15-26
010 011	25	Improving Reverse Osmosis Performance Through Perioic Cleaning (S. I. Graham, et al.)	Desalination Vol. 74, NO. 1/3, 1989, p113-124



APPENDIX R3-3





APPENDIX R3-3 Summary of Main Papers

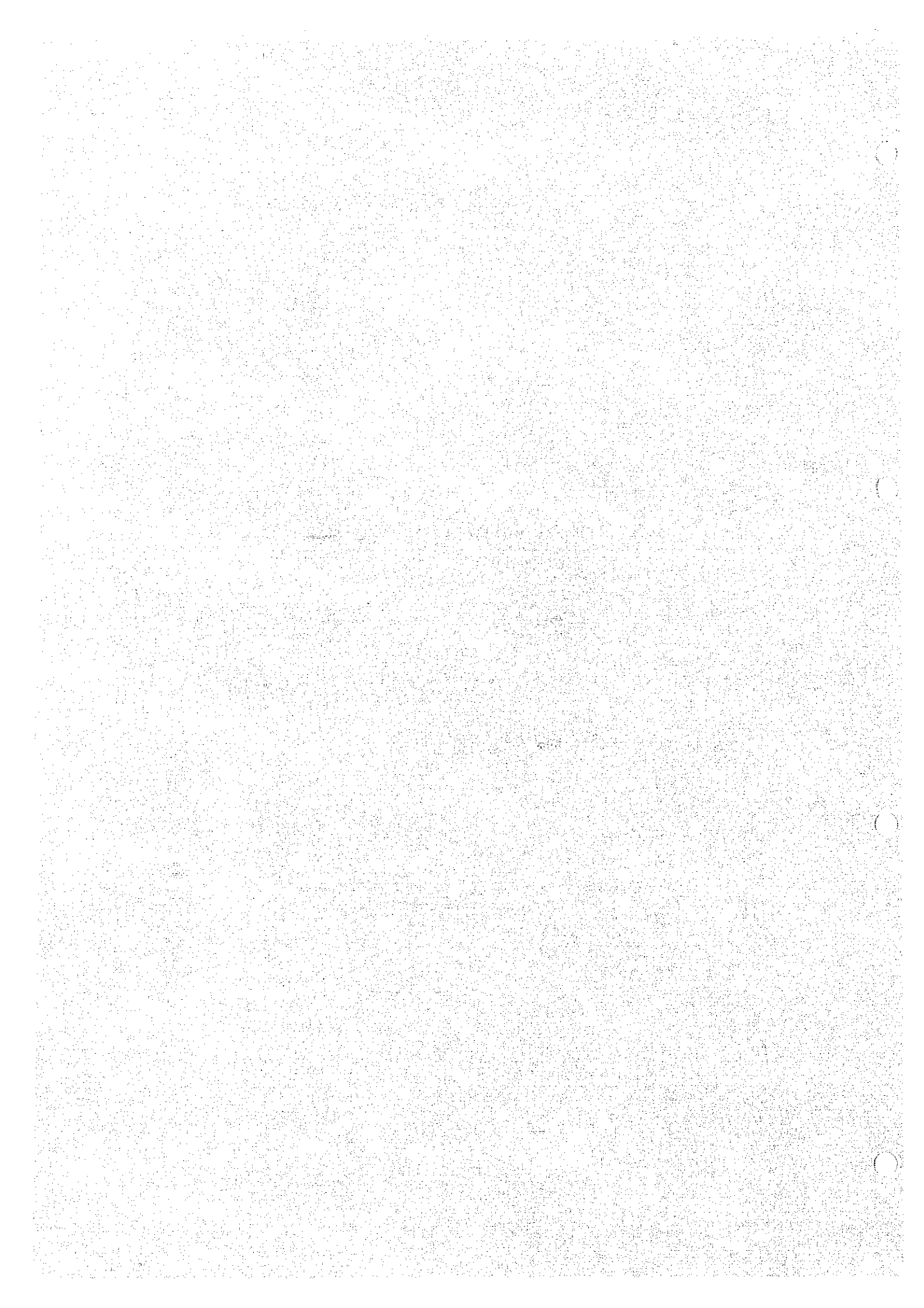
No.	Title, Author	Source	Contents
1 (File No. 010 011)	Wastewater Treatment : ion-exchange membrane method (J. Tanaka, S. Itoi)	P P M Vol. 7, No. 3, 1976 p41-52	<p>Electrodialysis system with ion-exchange-membrane is reported. This system is adopted in Benghazi-city Waterworks, Zilten-city Waterworks and Beer-Brewage Water.</p> <p>Treatment scale ;</p> <p style="padding-left: 40px;">Benghazi-city Waterworks : 19,000 m<sup>3</sup>/ Day</p> <p style="padding-left: 40px;">Zilten-city Waterworks : 330 m<sup>3</sup>/ Day</p> <p style="padding-left: 40px;">Beer-Brewage Water : 670 m<sup>3</sup>/ Day</p>
2 (File No. 010 011)	Macromolecular Membrane Separation	Chemical Equipment Vol. 32, 1990 p88-99	<p>General matters of macromolecular membrane separation system is reported in this paper.</p> <p>As the general consideration, some washing methods of membrane module is reported.</p> <p>Type of foulings and shape of membrane must be considered at selecting the method of washing.</p> <p>Setting of washing period is a matter of importance.</p> <p>This paper shows kinds of washing methods, too.</p>

No.	Title, Author	Source	Contents
3 (File No. 010 011)	Drinking Water from the Sea: Reverse Osmosis, in Ehime (F. Kawamata)	Ebara infirco, Report No. 83, 1981	<p>Reverse Osmosis Desalination System is reported.</p> <p>1) Equipment</p> <p>Method : 1-stage Desalination by Reverse Osmosis</p> <p>Pre-Treatment : Plural Separator, Sand Separator Precision Separator</p> <p>Post-Treatment: Deacids tower, Lime Column</p> <p>Chemicals : Sterilization <math>\text{NaClO}</math> ( 2 ~ 3 mg/l as <math>\text{Cl}_2</math> )</p> <p>: Flocculation <math>\text{FeCl}_3</math> ( 1.5 ~ 3 mg/l as Fe )</p> <p>: pH regulation <math>\text{H}_2\text{SO}_4</math></p> <p>: Scal prevention (<math>\text{NaPO}_3</math>).</p> <p>Membrane : TOYOBO HR-8350</p> <p>Recovery rate : 30 %</p> <p>2) Separator of pre-treatment</p> <p>1st stage : Fl &gt; 4</p> <p>2nd stage : Fl 2 ~ 3</p> <p>After 2nd-separation : 0.02 mg/l ( Conc. of Fe )</p> <p>Washing frequency : 1st stage 1 Time/Day 2nd stage 1 Time/2 ~ 3 Day</p> <p>Flocculation : 1.5 mg/l as Fe</p> <p>3) Treatment for Wastewater</p> <p>Not Reported</p>

No.	Title , Author	Source	Contents
4 (File No. 010 011)	Report of a Desali nation System in Nagasaki (J. Kijima, M. Kunitomo)	Water-Making Technology Vol. 8, No. 1 1982 P39-43	<p>1)Equipment ( 30 m<sup>3</sup>/Day )</p> <p>Method : 2-stage Desalination by Reverse Osmosis</p> <p>Pre-Treatment : Pressure Filter, Safety Filter</p> <p>Chemicals : Sterilization NaClO</p> <p style="padding-left: 40px;">: Flocculation FeCl<sub>3</sub></p> <p style="padding-left: 40px;">: pH regulation H<sub>2</sub>SO<sub>4</sub></p> <p>Membrane : TO-RAY SC-5200</p> <p>Recovery Rate : 1st stage RO 40 %</p> <p style="padding-left: 80px;">2nd stage RO 83.3 %</p> <p>Product-water Quality : &lt; TDS 500 p. p. m.</p> <p>2)Chemical Washing</p> <p>Chemical : Citric acid</p> <p>Period : After 15 months driving</p> <p>Iron tips was recognized on the membrane.</p> <p>3)Treatment for Wastewater</p> <p>Wastewater from Pressure Filter : No Treatment</p> <p>Concentrated sea water : No Treatment</p> <p>Wastewater from Chemical Washing : Not Reported</p>

No.	Title , Author	Source	Contents
8 (File No. 010 011)	Design of Waste- water Treatment System (N. Mizorogi)	Water Vol. 25, No. 3 1983, p36-40	This paper is a serial story of wastewater treat- ment. R. O. system is reported in this paper. Two methods ( Flushing, Chemicals ) is reported in this paper.  Chemicals : Citric acid Ammonium Citrate Enzyme

APPENDIX R 3 - 4



APPENDIX R3-4 Report of Treating Waste Water contained Formalin

No.	Title , Author	Source	Contents
2 6	Wastewater Treatment with Bio-Membrane  (T. Hano)	Chemical Engineering  Vol. 35, No. 10  1990, p816-821	Aerobic and anaerobic decomposition rate and the study sample of bio-membrane treatment.  This study report mentions to decomposition rate of wastewater contained not only phenol but also formaldehyde.
2 7	Elimination of methanol, formaldehyde and formic acid contained in various electrolytes using a air-local cell system  (T. Furuya)	Industrial Water  No. 381, 1990,  p11-16	Study of method that oxidation decomasotion of Cl-compound from wastewater contained Cl-compound as formalin or formaric acid.  On condition that electroytic solution pH is less than 3, independent of electlytic solution's kind and concentration, Cl-compound reacts axygen in the atmosphere and can be decomposed CO <sub>2</sub> and H <sub>2</sub> O on gas electrode.
2 8	Elimination of methanol, formaldehyde and formic acid contained in various electrolytes using a air-local cell system  (T. Furuya)	Industrial Water  No. 385, 1990,  p55-60	Detail study of decomasition behavior of formaldehyde. On consideration that pH<7, it is oxidized completely in the atmomosphere and is decomposed CO <sub>2</sub> and H <sub>2</sub> O . In the case of pH<7, formic acid is produced. in the case of pH>12, formic acid is produced perfectly.

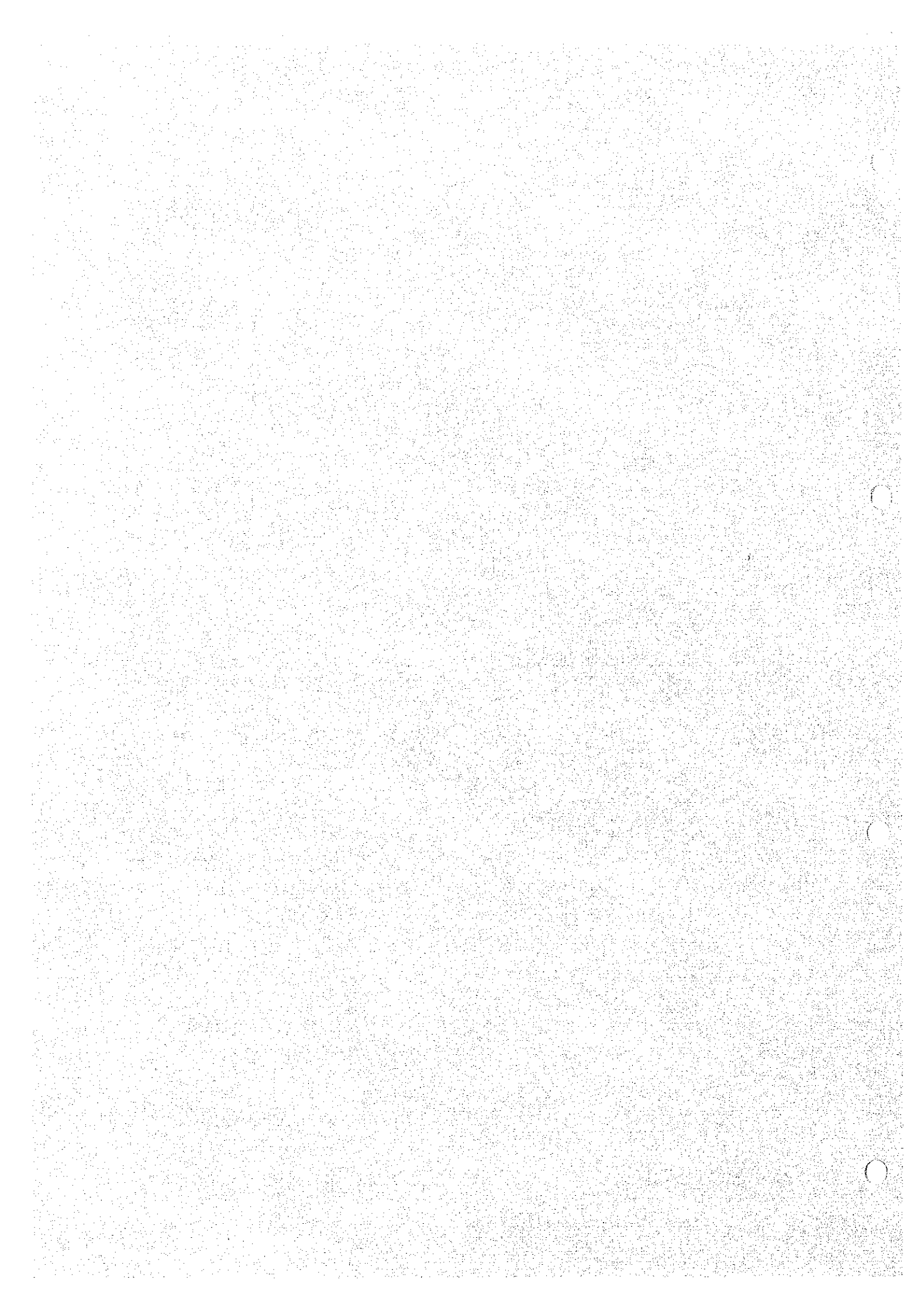


No.	Title , Author	Source	Contents
2 9	Removal of mixed substrates, phenol and formaldehyde, in activated sludge. (K. Hosaka)	Water Treatment Technology Vol. 31, No. 4 1990, p205-212	Batch and continuous experiment that treat phenol and formaldehyde composite matrix by activated sludge.  Formaldehyde is removed in 1st stage without acclimatization of sludge.
3 0	Biological Treatment for Wastewater contained phenol, m-cresol formaldehyde (K. Hosaka)	Chemical Engineering Dep. Vol. 55, 1990 p426	Result of the experiment that the biological treatment for the wastewater contained phenol, m-cresol formaldehyde; two kind of method as follows; and filter bed that used a ringrace. Sludge is acclimatized.
3 1	Biological degradation of phenol and formaldehyde mixture (K. Hosaka)	Quality of Water Dep. Vol. 23, 1989 p85-86	Results of two kinds of experiment for the composite wastewater contained phenol, m-cresol formaldehyde
3 2	Stoerungen der Funktion biologischer Kläranlagen durch Chemikalien: Vergleich der Grenzkonzentration mit Ergebnissen im Sauerstoffzehrungstest. (W. Guhl, ... GODE)	Vom Wasser Vol. 72, 1989 p165-173	Experimental measurement results that a kindrance degree of mixing leven chemical materials within formaldehyde giving effect to biological treatment of wastewater.

No.	Title , Author	Source	Contents
3 3	Versuche zum Verhalten microbizider Verbindungen in Kläranlagen. 3. Mitteilung: Formaldehyd J. Raff L. Weil W. Hegemann	GWF Wasser Abwasser Vol. 130, No. 8 1989, p392-397	Measurement of formaldehyde's toxicity giving to activated sludge, adsorption of formaldehyde to activated sludge, and decomposition behavior of activated sludge to formaldehyde.
3 4	A Fenton-like reaction to neutralize formaldehyde waste solutions. A. P. Murphy W. J. Boegli M. K. Price C. D. Moody	Environ. Sci. Technol. Vol. 23, No. 2, 1989, p166-169	Study of method that is similar to Fenton reaction, in order to treat with industrial wastewater contained formaldehyde; oxidation of formaldehyde by H <sub>2</sub> O <sub>2</sub> with catalyst of Fe <sup>2+</sup> .
3 5	The Process Utility of Thermotolerant Methylotrophic Bacteria: I. An Evaluation in Chemostat Culture	Biotechnology and Bioengineering Vol. 36, 1990 p816-820	Thermotolerant methylotropic bacteria in chemostat steady continuous culture showed high tolerance. In case of applying to industrial wastewater on condition that more than 0.2/Hr dilution rate, methanol was complete consumed and biomass generation is little.



APPENDIX R 3 - 5



APPENDIX R3-5 Results of Chemical Analysis for RO Plant  
in Haql

Description	Feed	Brine
pH	6.14	6.17
Conductivity us/Cm	53800	76400
TDS mg/L	37600	54200
Temperature °C	22.5	21.2
Turbidity NTU	0.37	0.38
SDI	0.80	-
TH as CaCO <sub>3</sub> mg/L	6700	10300
Ca as CaCO <sub>3</sub> mg/L	1050	1500
Mg as CaCO <sub>3</sub> mg/L	5650	9800
Chloride as Cl <sup>-</sup> mg/L	20330	30167
Carbonate as CO <sub>3</sub> mg/L	Nil	Nil
Bicarbonate as HCO <sub>3</sub>	50	74
Total Alkalinity as CaCO <sub>3</sub> mg/L	50	74
Carbon dioxide as CO <sub>2</sub> mg/L	38.72	56.32
Res. Chlorine as Cl <sub>2</sub> mg/L	0.25	0.25

