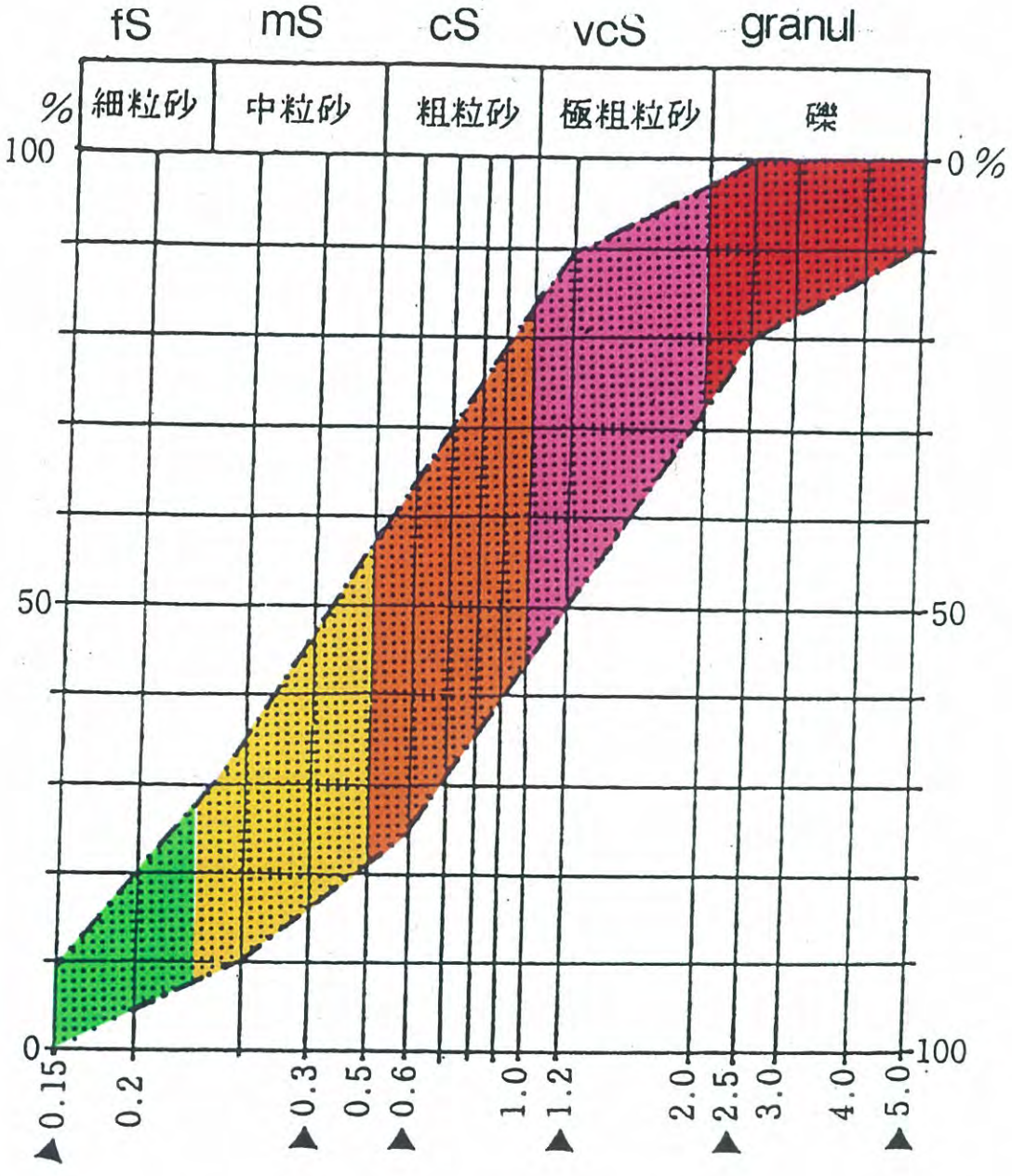
Evaluation methods for quality of fine aggregate

by Dr. Masafumi ARITA
retired member of GSJ

Standard Grain Size of Fine Aggregate in JIS

Mesh interval (mm)	Weight % of passed grains	
	finer limit	coarser limit
10	100	100
5	100	90
2.5	100	80
1.2	90	50
0.6	60	25
0.3	30	10
0.15	10	2



第２図　細骨材の標準粒度範囲

grain size standard for fine aggregate

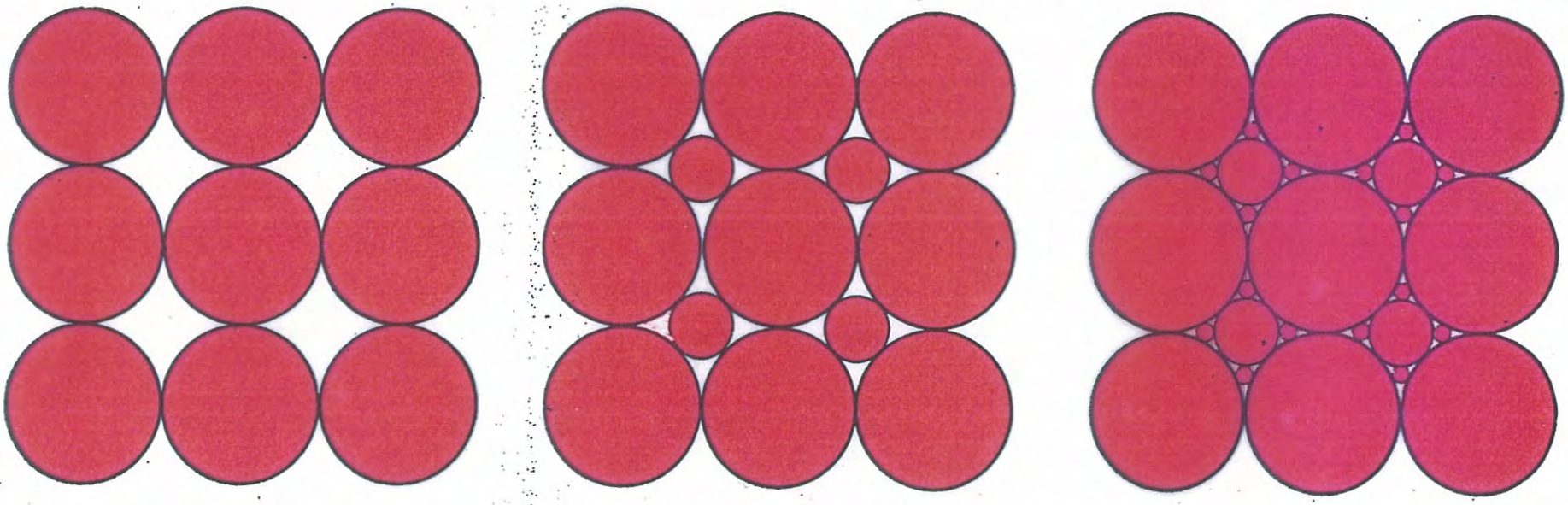
大さを異にする砂粒の混合狀態と

Relation between three types of grain size combination and their porosity

第二圖

bad as fine aggregates

good as fine aggregates



一種類の場合

二種類の場合

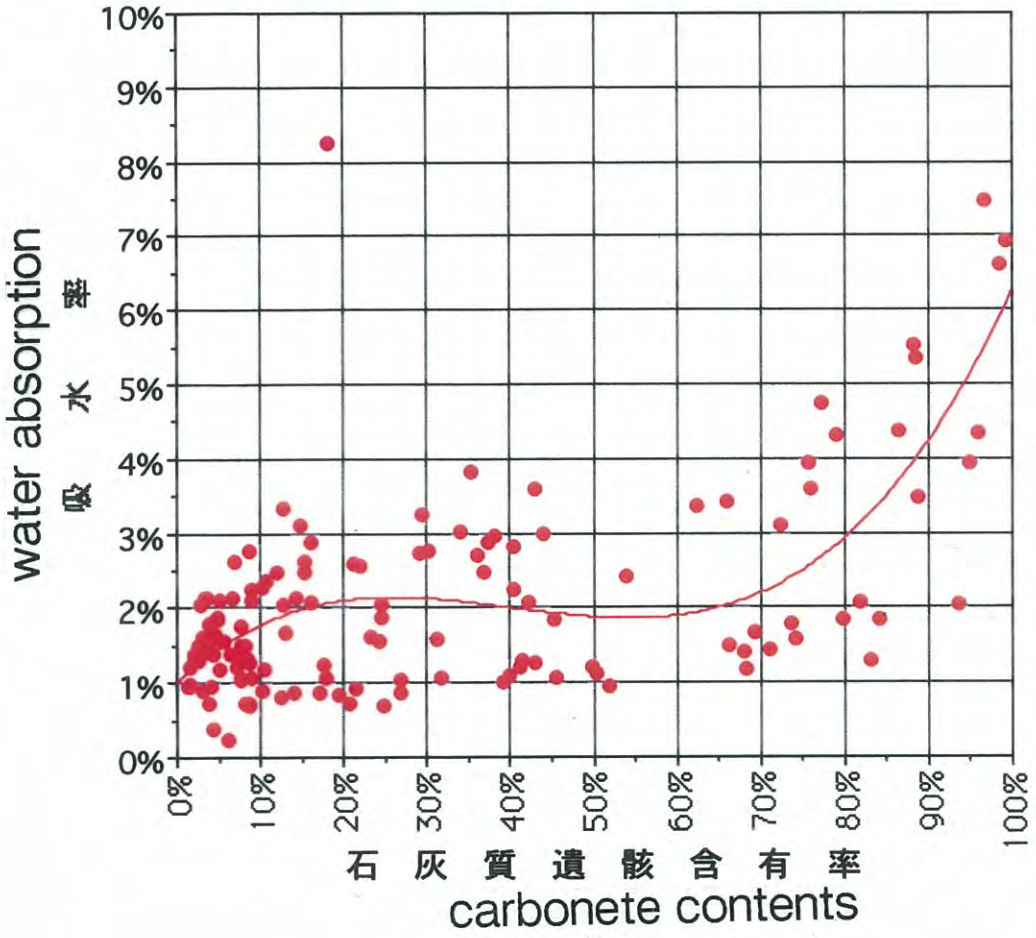
三種類の場合

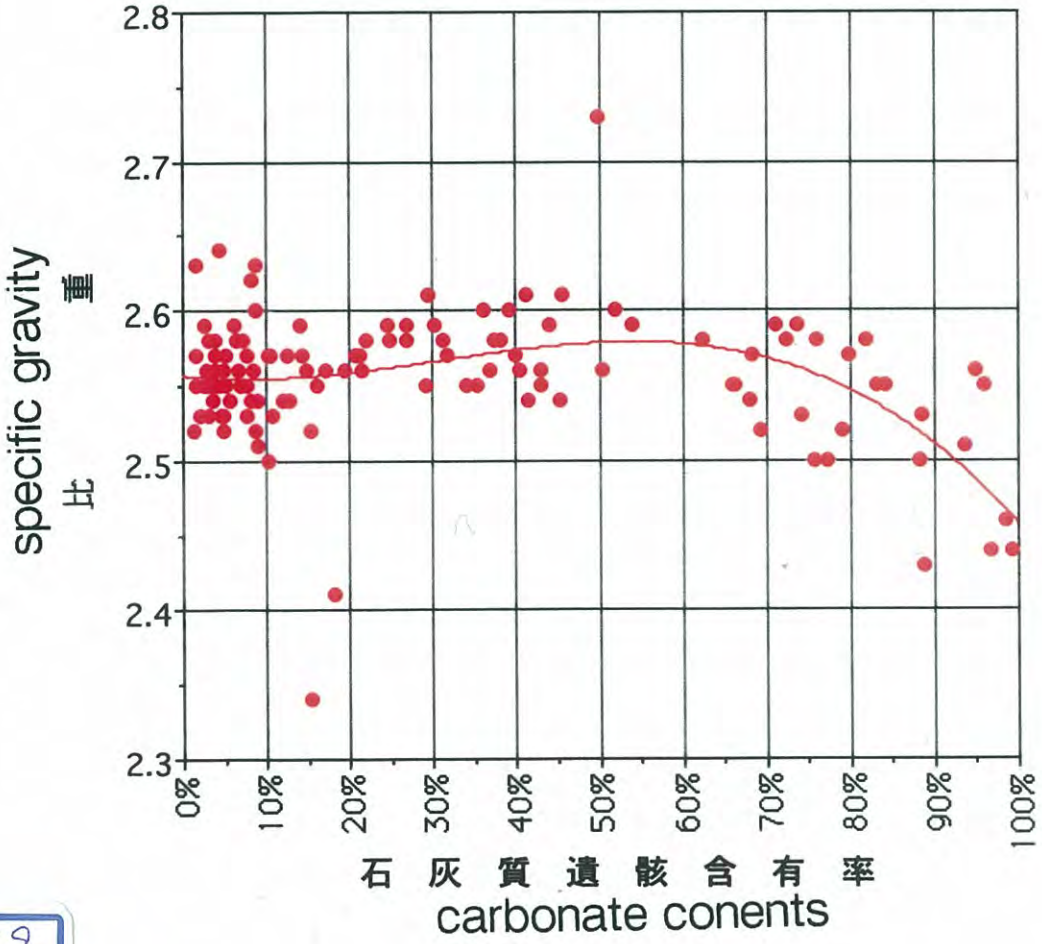
well sorting sand

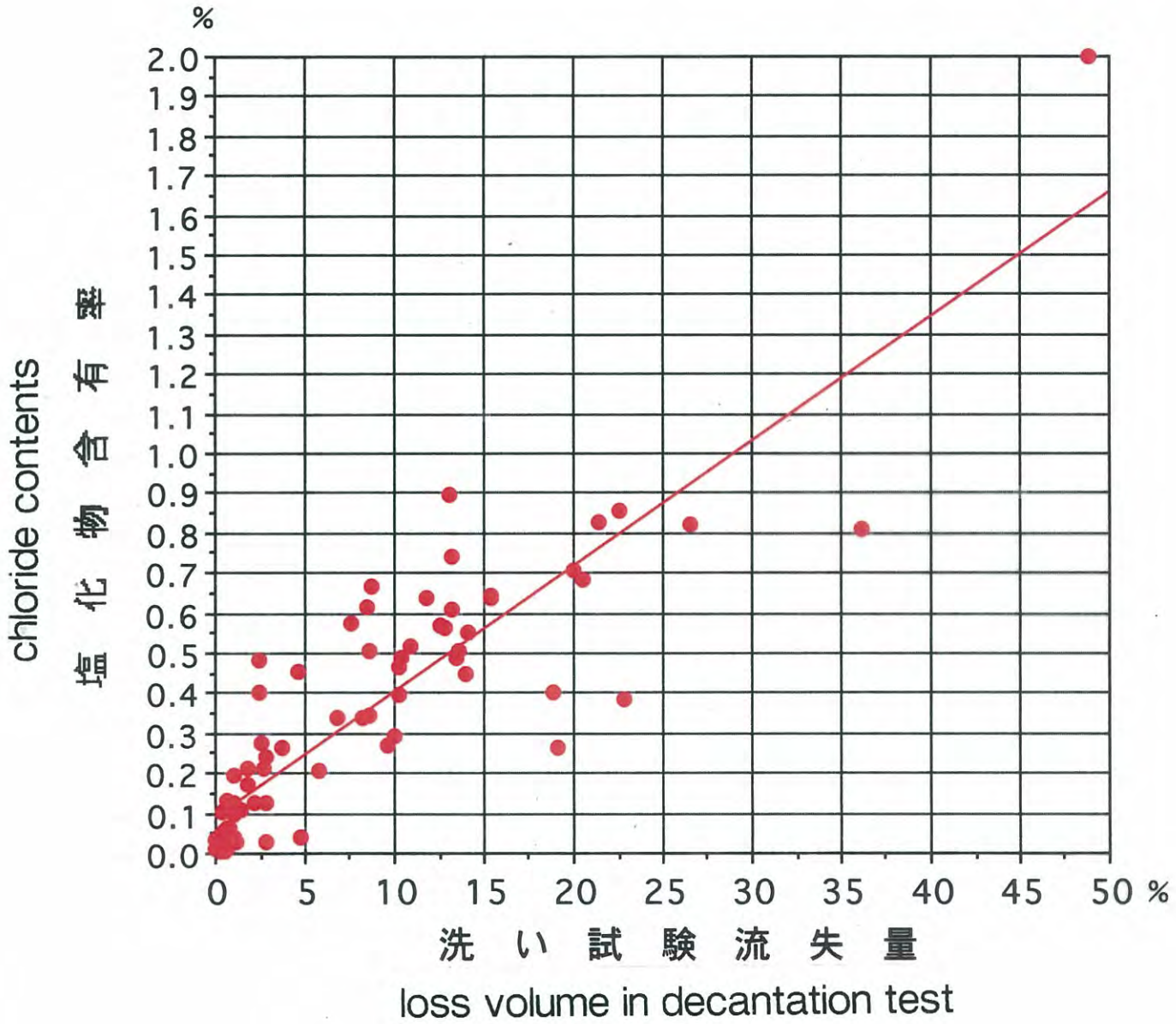
bad sorting sand

Example of calculation of fineness modulus for sand

Size of mesh (mm)	(1) Percentage of trapped grains	Cumulative percentage of (1)
40	—	—
20	—	—
10	—	—
5.0	4	4
2.5	11	15
1.2	22	37
0.6	25	62
0.3	23	85
0.15	13	98
Total		301
Fineness Modulus(F.M)		301/100 = 3.01


water absorption
吸水率
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
石灰質遺骸含有率
carbonete contents


specific gravity
比重
2.8
2.7
2.6
2.5
2.4
2.3
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
石灰質遺骸含有率
carbonate conents


%
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
chloride contents
塩化物含有率
0
5
10
15
20
25
30
35
40
45
50 %
洗い試験流失量
loss volume in decantation test

評価表凡例

EVALUATION STANDARD OF FINE AGGREGATE

Grain size compared with standard size	Finer	Similar	Good	Coarser	
Evaluation symbol	●	△	○	◇	
Fineness Modulus	less than2.20	2.20~2.60	2.60~3.10	3.10~3.50	over than3.50
Evaluation symbol	●	△	○	△	◇
Loss volume of decanntation test	over than10%	10~5%	less than 5%		
Evaluation symbol	●	△	○		
Oganic material contents	30%over than	30~10%	less than 10%		
Evaluation symbol	●	△	○		
Absolute -dry specific garavity	less than2.40	2.40~2.50	2.50~2.70	over than 2.7	
Evaluation symbol	●	△	○	▲	
Water absorption	over than4%	3~4%	less than 3%		
Evaluation symbol	●	△	○		
Chloride contents after washed by fresh water		less than 0.1% general concrete	less than 0.04% bridge,blg.		
Light materials than s.g.1.95 ex.pumice			less than 5%		

Sample No.	Water depth	1	2	3	4	5	6
1	74.0m	△	●	○	△		
2	72.0m	△	△	○	○	○	○
3	85.6m	●	●	△	△		
4	88.6m	●	●	○	●		
5	92.6m	△	●	○	●		
6	129.0m	●	●	○	●		
8	80.0m	●	●	△	△	○	○
9	72.1m	△	△	○	△	○	○
11	68.0m	●	●	△	●	△	○
37	51.0m	○	○	○	○	○	○
38	37.6m	○	○	○	○	○	○
41	40.0m	●	●	○	○	○	○
50	48.0m	◇	△	○	●	●	●
51	35.1m	◇	◇	○	●		

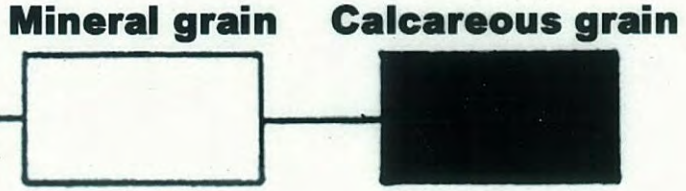
Example of Evaluation of Aggregate Test for Offshore Sand

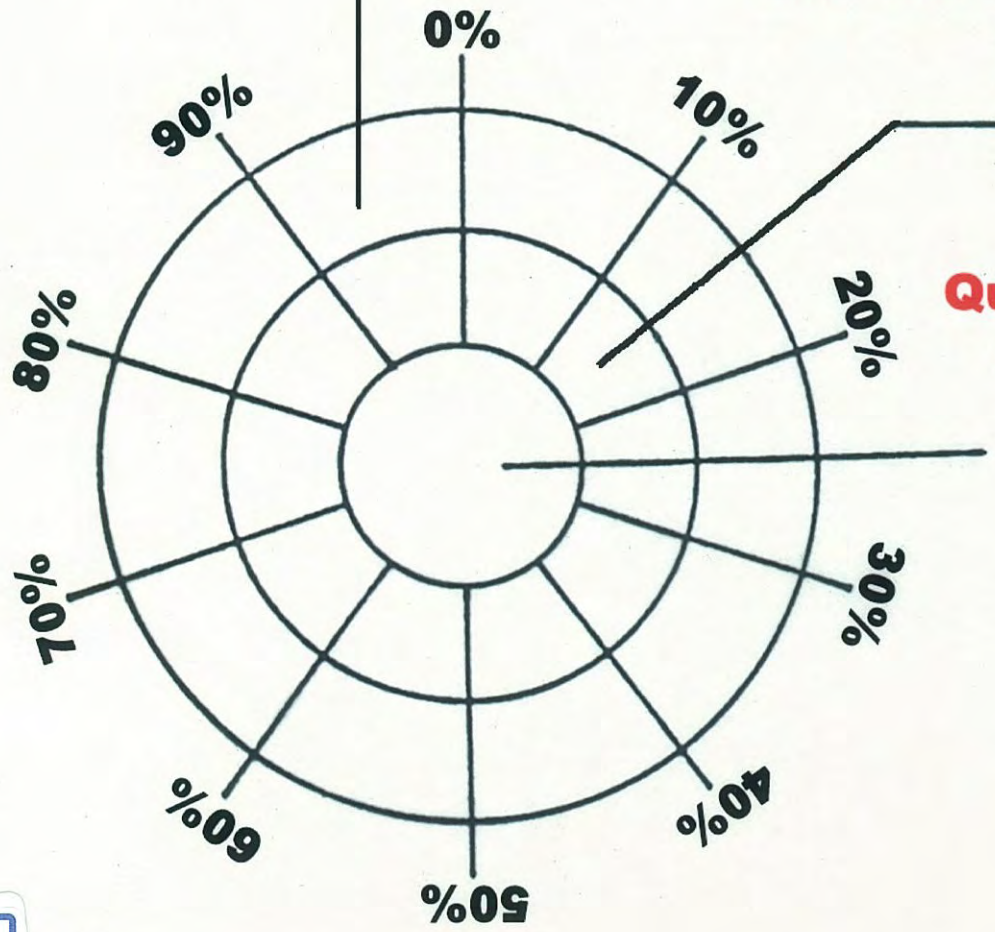
1.Grain sizae compared with standard size
2.Fineness Modulus
3.Loss volumes of decantation test;
Contents of finer grains than 75 microns
4.Organic material contents
5. Absolute-dry specific garavity
6.Water absorption ratio

52

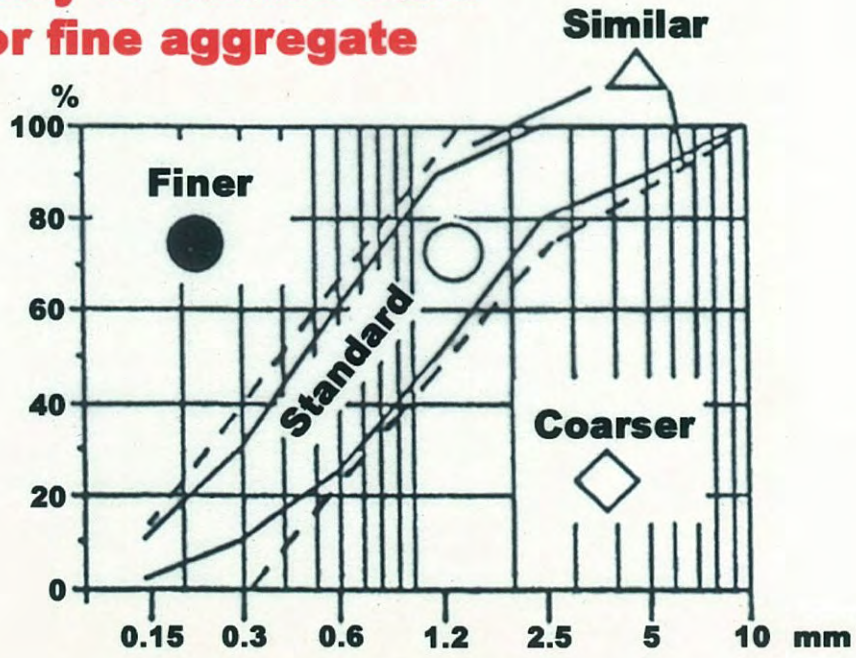
Grain size composition

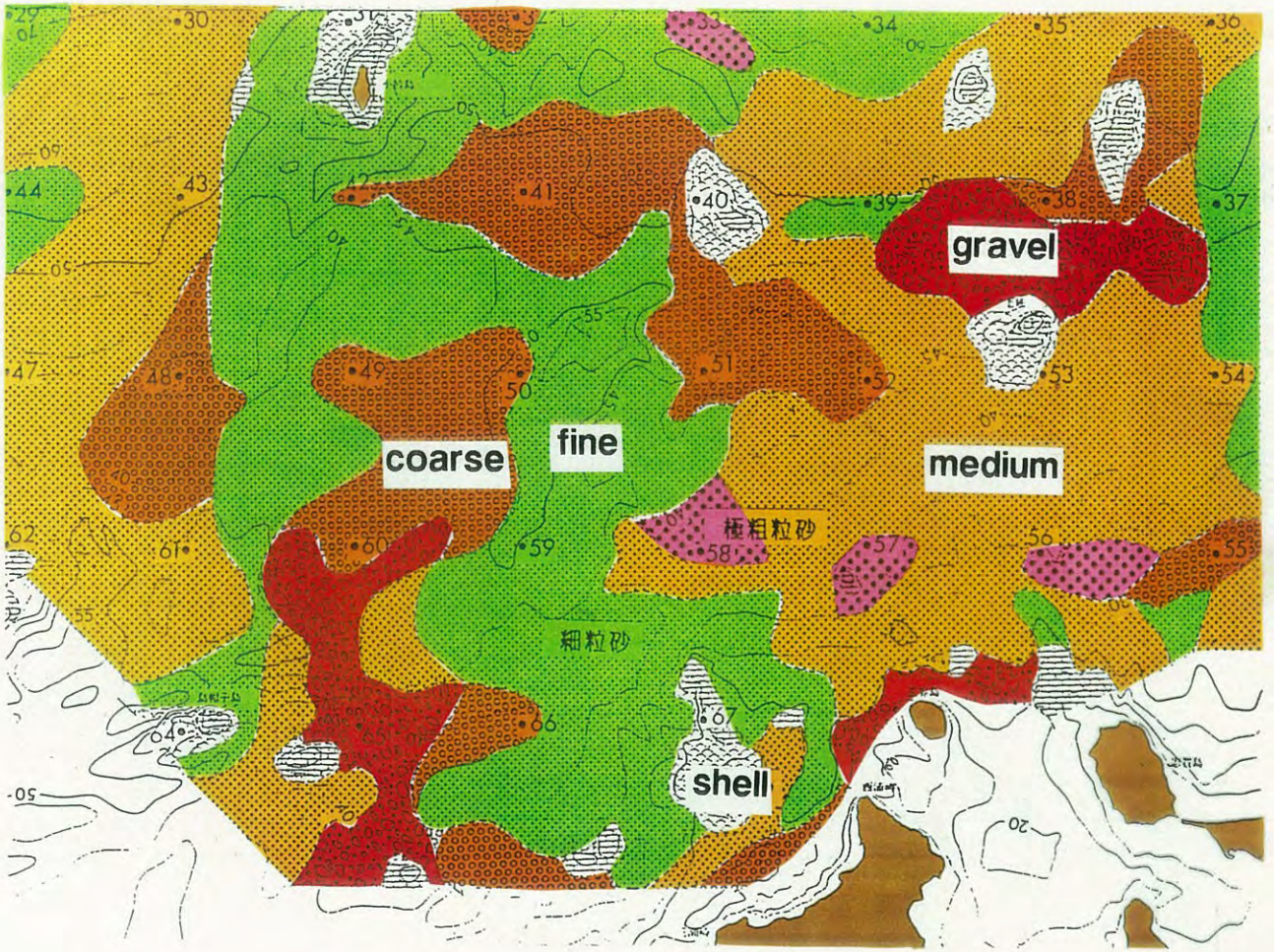
Ratio between calcareous and mineral grain

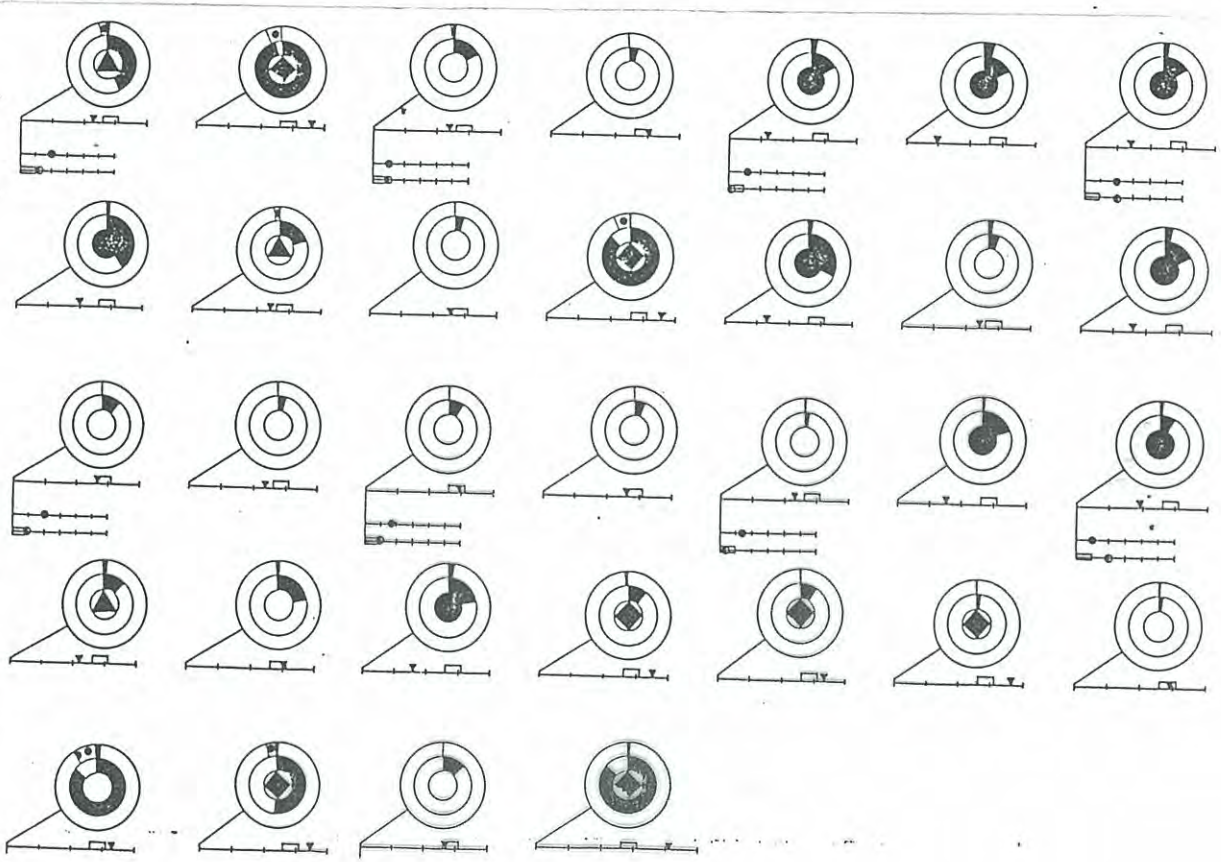




Quality of marine sand for fine aggregate




gravel
coarse
fine
medium
極粗粒砂
細粒砂
shell



第７図　底質分布と細骨材資源としての評価例（玄界灘）

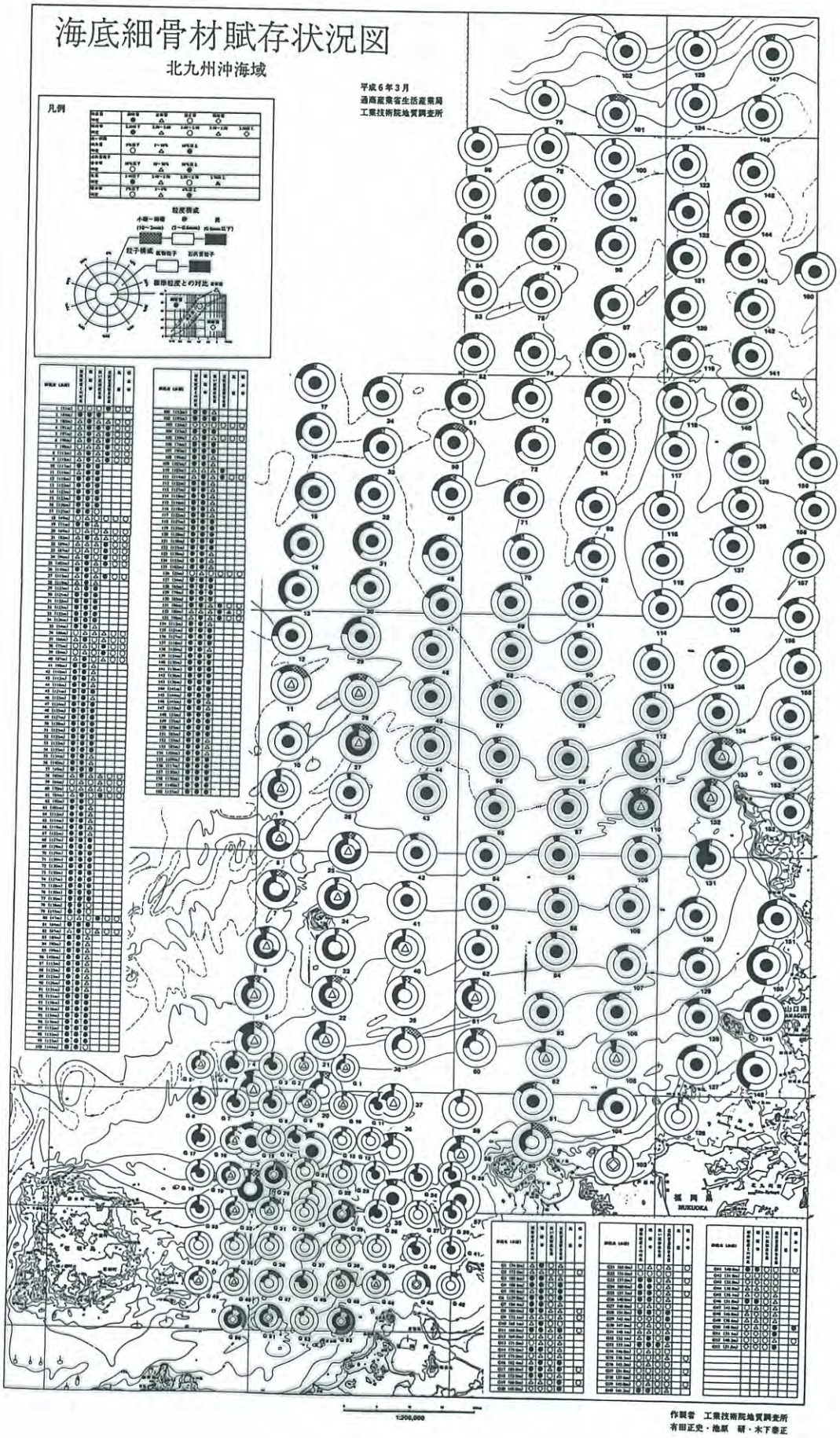
第７図には、玄界灘海域における底質分布と細骨材としての資源評価の例が示してある。　北九州の海域は、我が国で、もっとも広い大陸棚の発達している海域である。この海域では、礫～細粒砂が複雑な分布をしている。

粗粒砂の分布は、水深40m ～50m の海域の一部に分布している。　この粗粒砂は、円磨された石英粒からなり、この石英粒の表面は薄い酸化鉄の被膜で覆われ、褐色を呈している。　細骨材資源としての海砂の分布は、粗粒砂の分布と一致している。

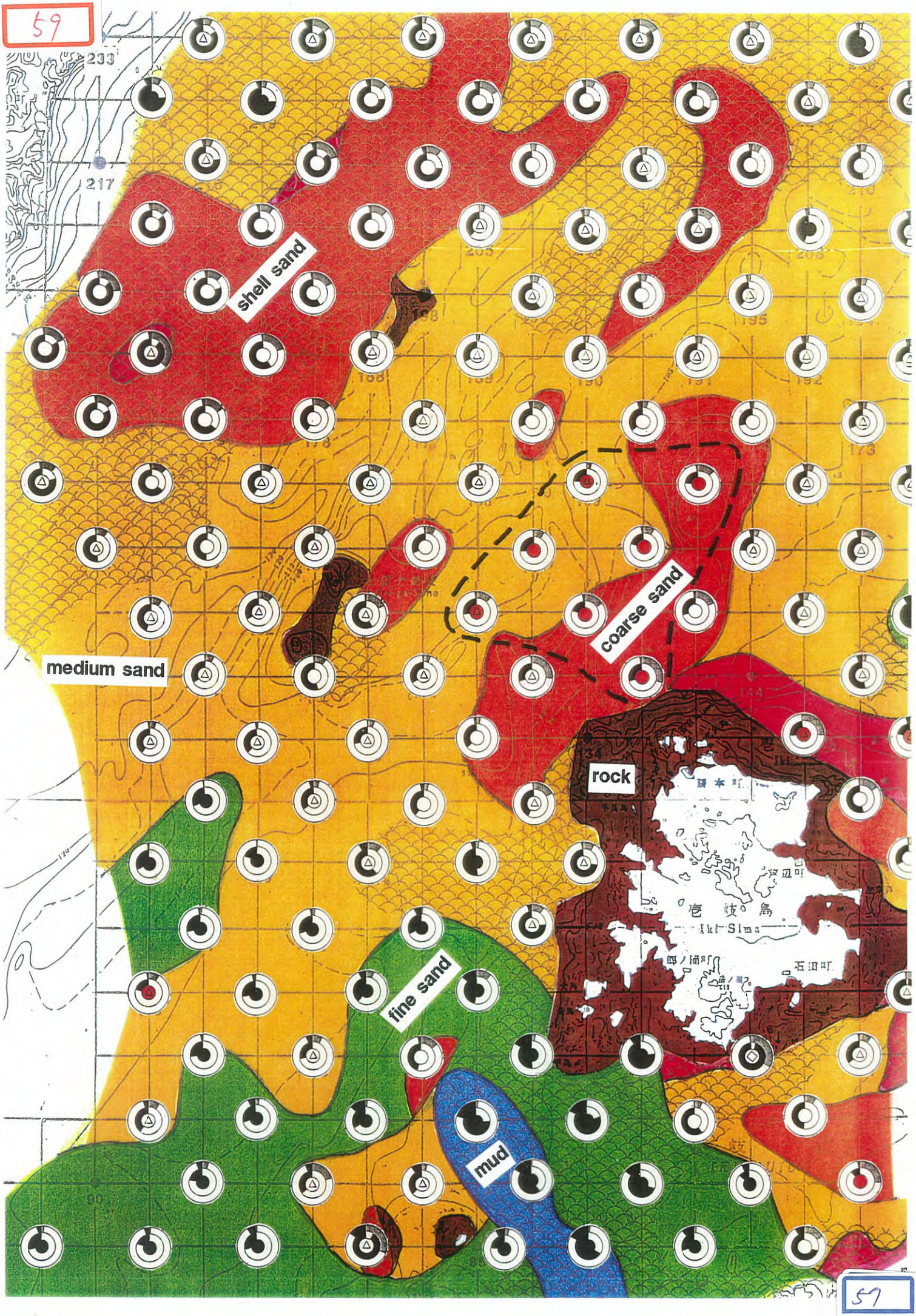
海底細骨材賦存状況図

北九州沖海域

平成６年３月
通商産業省生活産業局
工業技術院地質調査所



作製者　工業技術院地質調査所
有田正史・池原　研・木下泰正


shell sand
coarse sand
medium sand
rock
fine sand
mud
壱岐島
Iki-Sima

DISTRIBUTION MAP OF MARINE FINE AGGREGATE

SEDIMENTOLOGICAL MAP OF OFFSHORE JAPAN AND EVALUATION OF MARINE FINE AGGREGATE RESOURCES

Scale 1:2,000,000

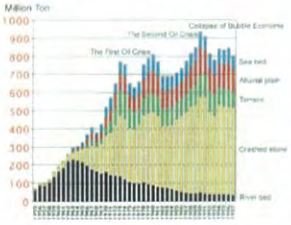
COMPILATION BY DR. MASAFUMI ARITA, GENERAL RESEARCH COUNCILOR

GEOLOGICAL SURVEY OF JAPAN

LEGEND OF EVALUATION TABLE

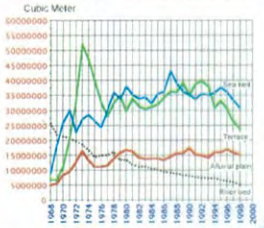
Grain Size Composition Type	Finer Type	Approximate Type	Suitable Type	Coarser Type	
Criterion for Decoding	●	△	○	◇	
Fineness Modulus	Below 2.20	2.20-2.50	2.50-3.15	3.15-3.50	Above 3.50
Criterion for Decoding	●	△	○	△	◇
Loss Volume of Decantation Test	Above 10%	10-5%	Below 5%		
Criterion for Decoding	●	△	○		
Calcium Carbonate Content	Above 35%	35-15%	Below 15%		
Criterion for Decoding	●	△	○		
Specific Gravity	Below 2.40	2.40-2.65	2.50-2.75	Above 2.75	
Criterion for Decoding	●	△	○	▲	
Water Absorption	Above 4%	3-4%	Below 3%		
Criterion for Decoding	●	△	○		

ANNUAL SUPPLY OF AGGREGATE IN JAPAN



ANNUAL SUPPLY OF GRAVEL FROM EACH SOURCE

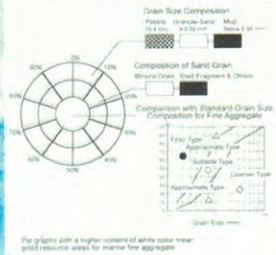
ANNUAL SUPPLY OF SAND FROM EACH SOURCE



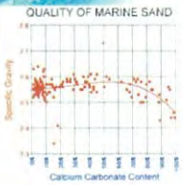
LEGEND OF SEDIMENTS

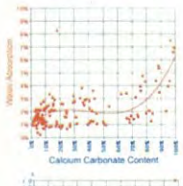
- CLAY
- SILT
- VERY FINE SAND
- FINE SAND
- MEDIUM SAND
- COARSE SAND
- VERY COARSE SAND
- GRAVEL
- ROCK

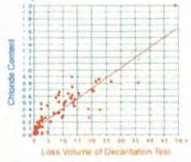
LEGEND OF PIE GRAPH



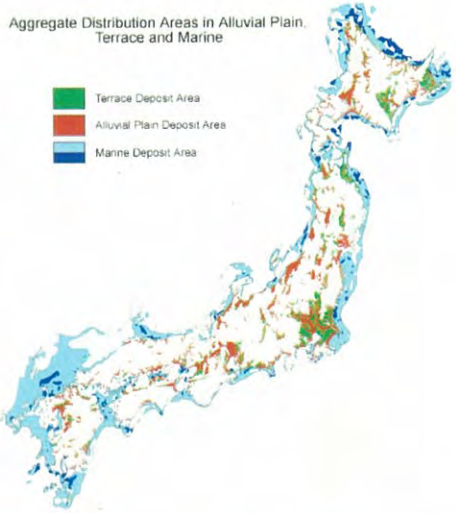
QUALITY OF MARINE SAND



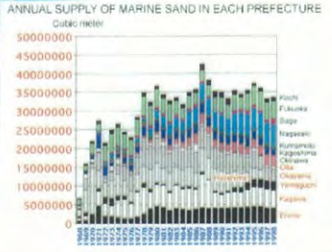




Aggregate Distribution Areas in Alluvial Plain, Terrace and Marine



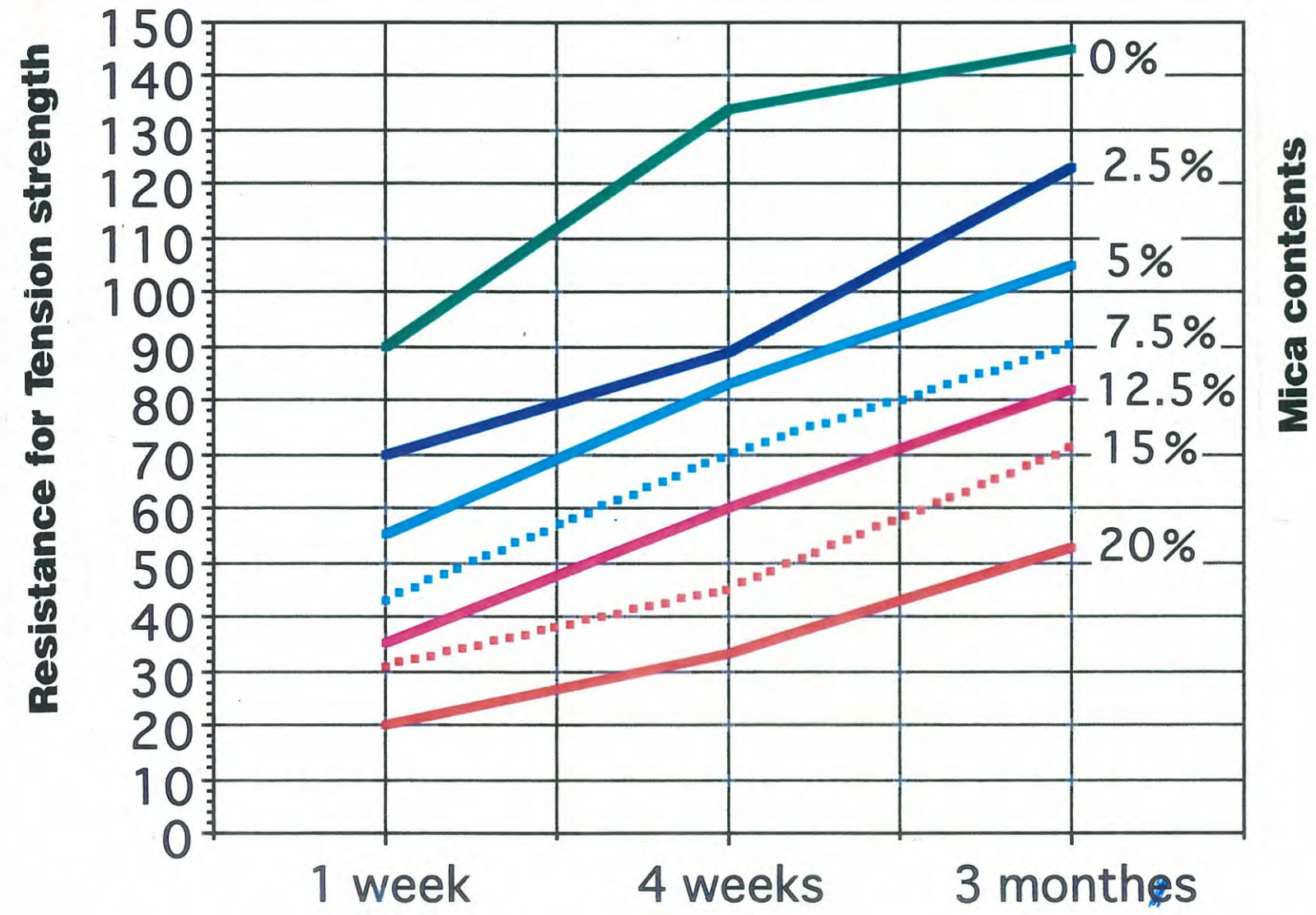
ANNUAL SUPPLY OF MARINE SAND IN EACH PREFECTURE



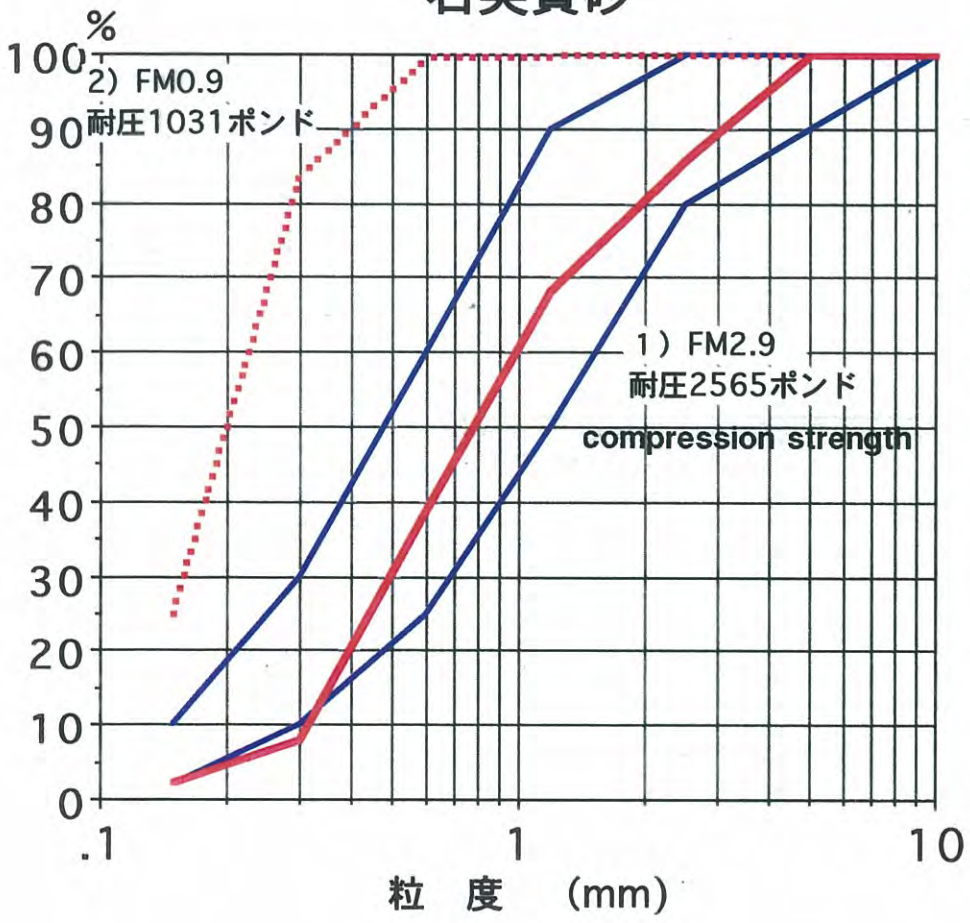
March 2000 Geological Survey of Japan

58

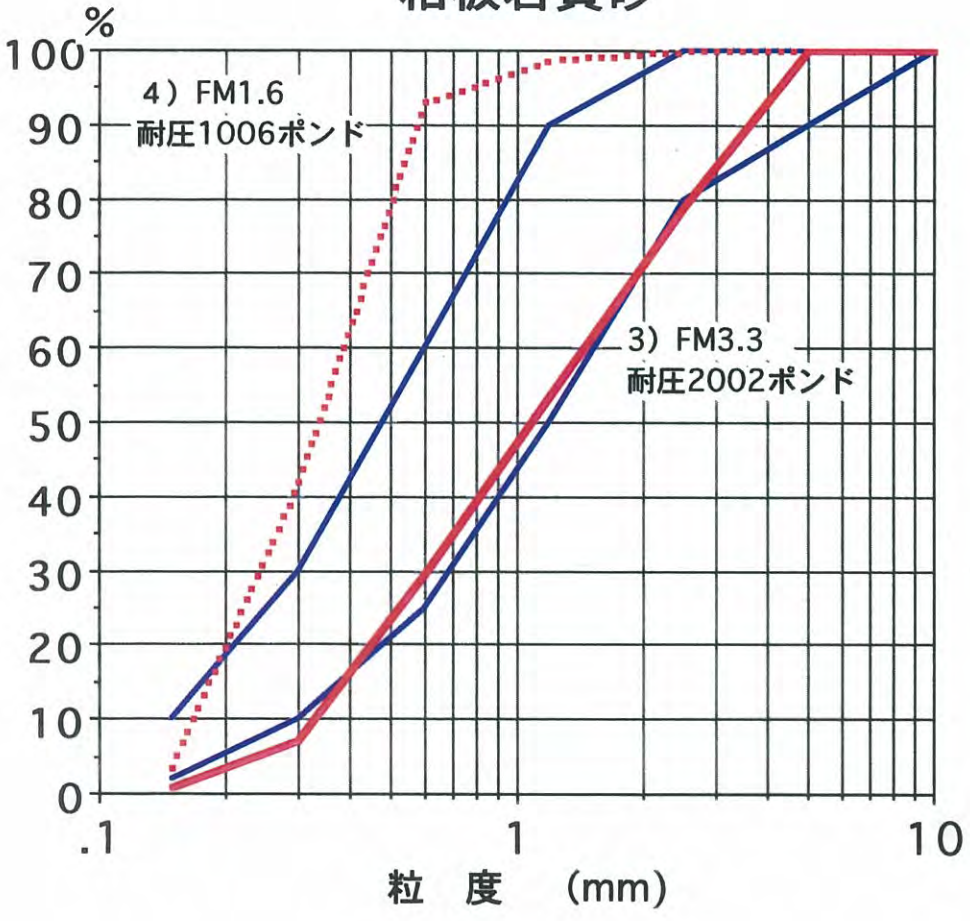
雲母の含有量と
引っぱり強度との関係



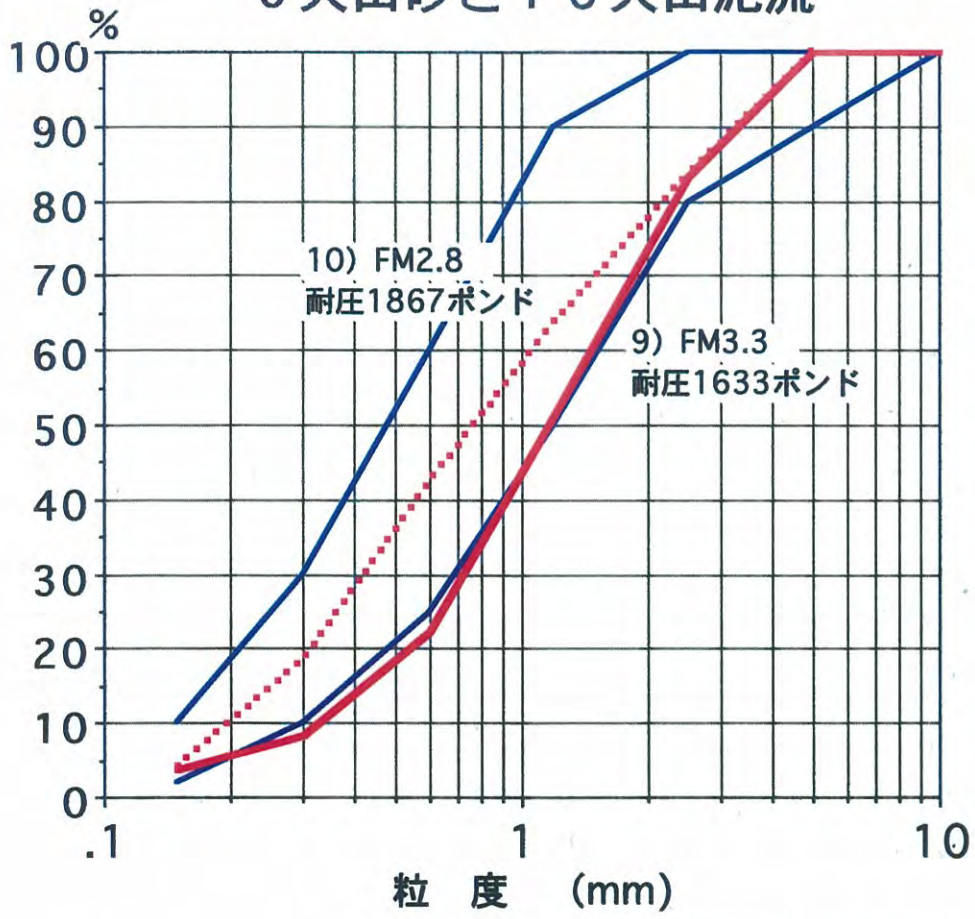
Quartz sand
石英質砂



粘板岩質砂

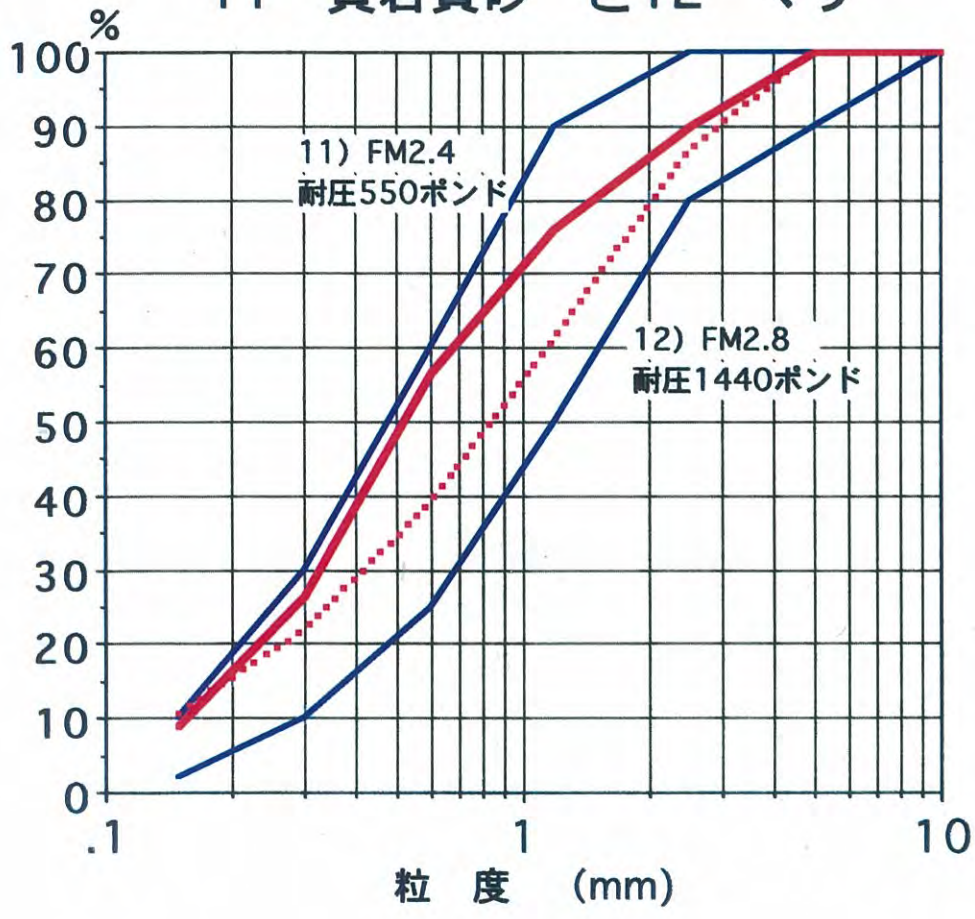


９火山砂と１０火山泥流



shale sand　　decomposed granite

11　頁岩質砂　と12　マサ



62

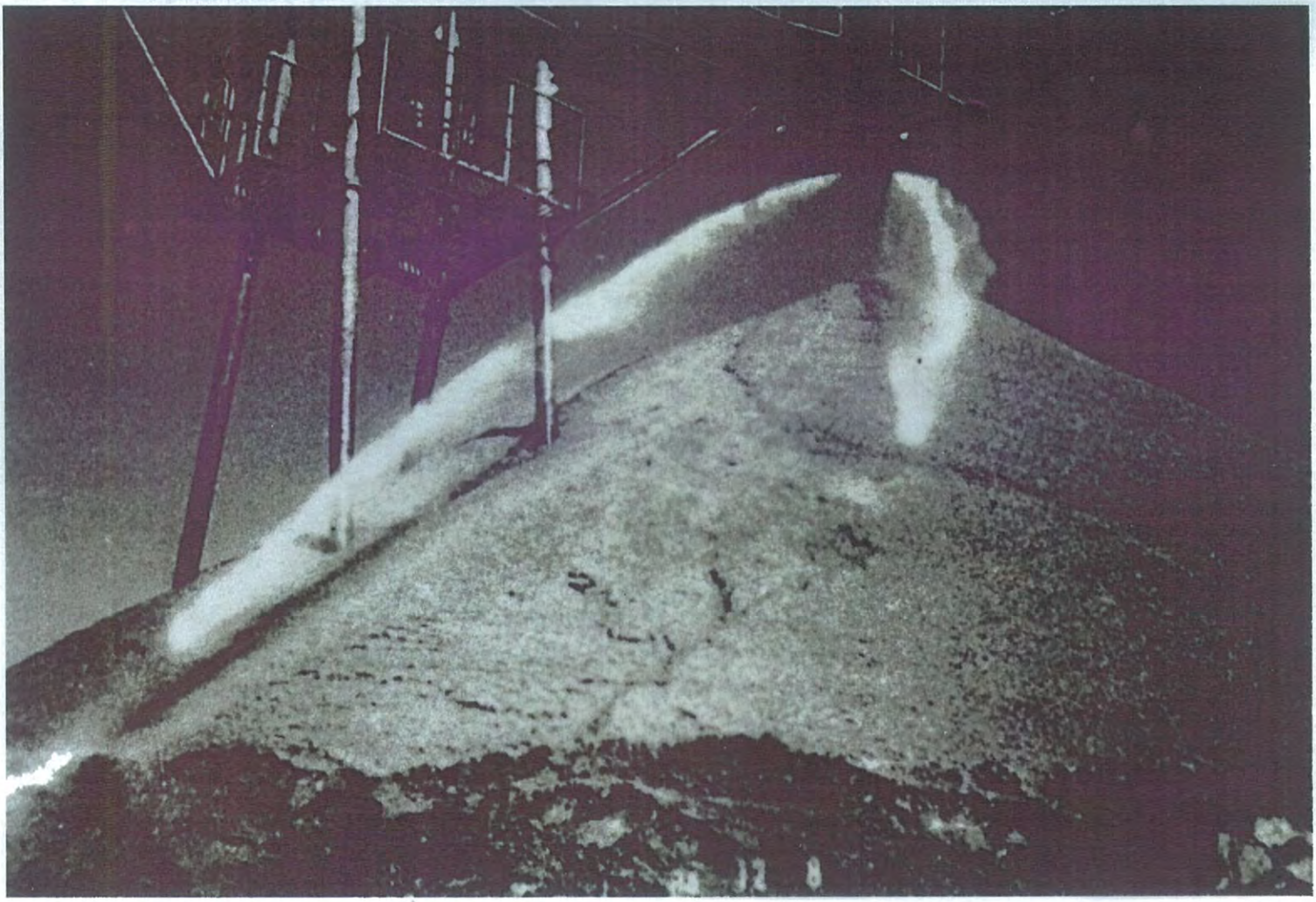
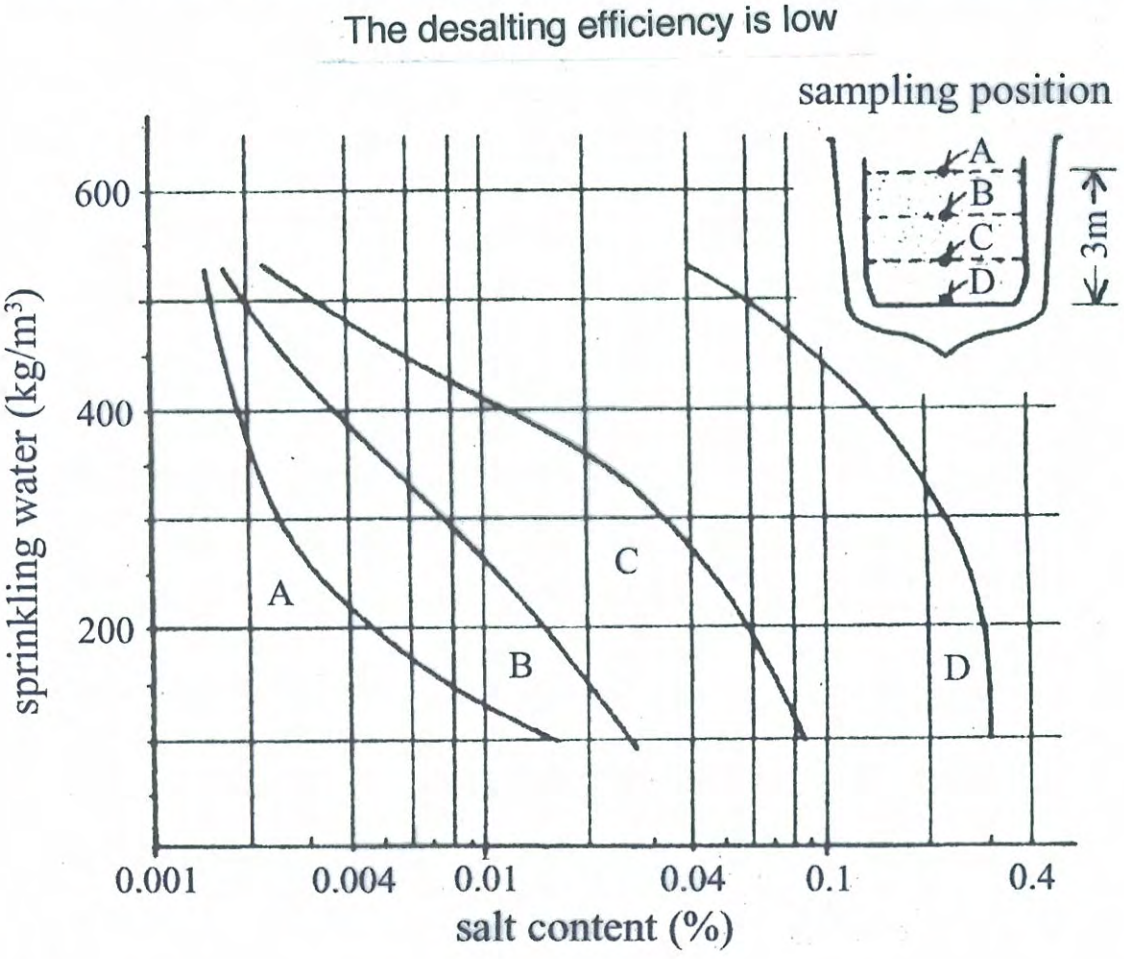


Figure 11. Sprinkling stockpiled sand to reduce salt content.



63

Figure 13. Test results of onboard sprinkling on desalting (Okamura 1980).

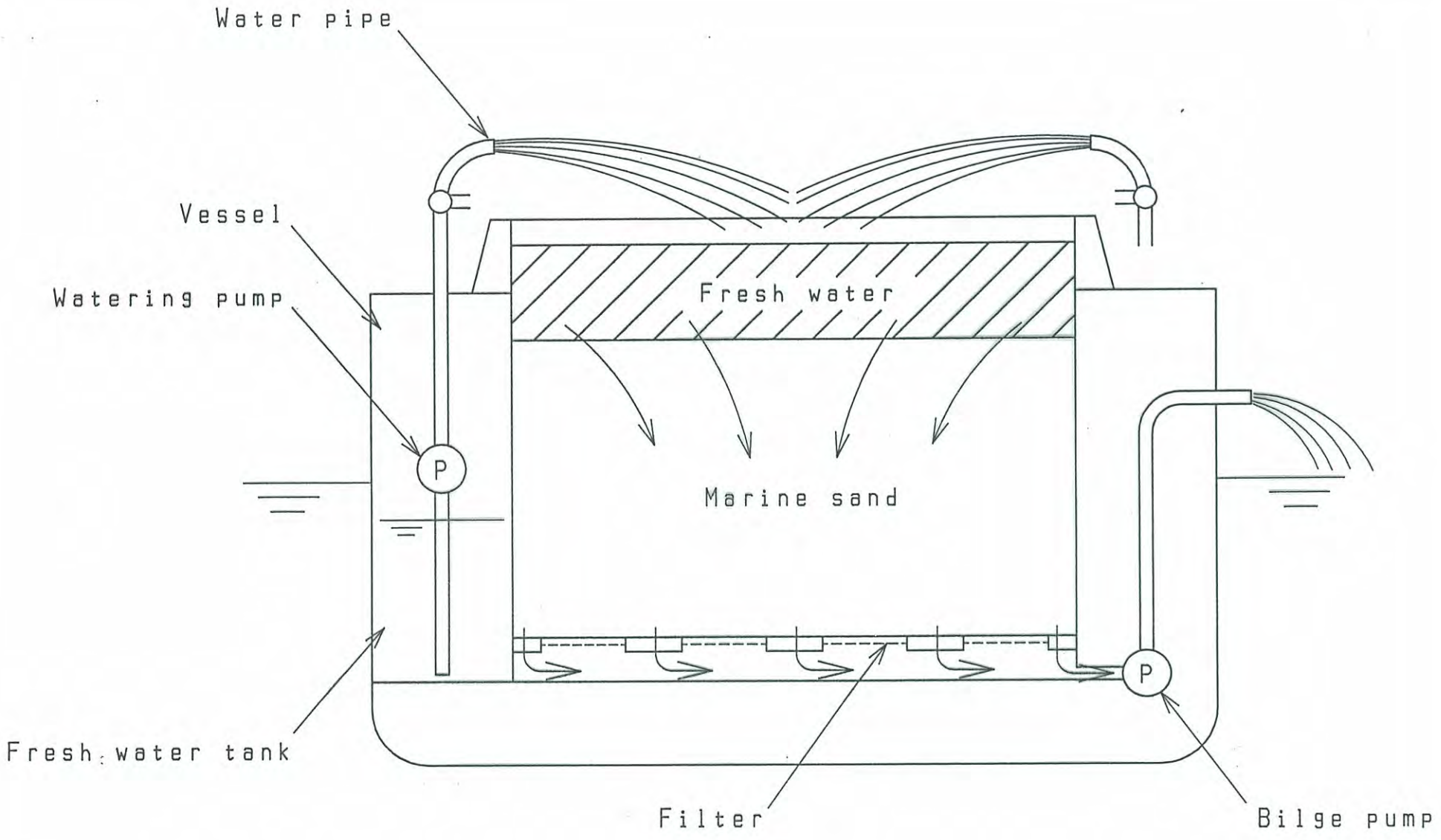


Fig. 15 On board desalting mechanism

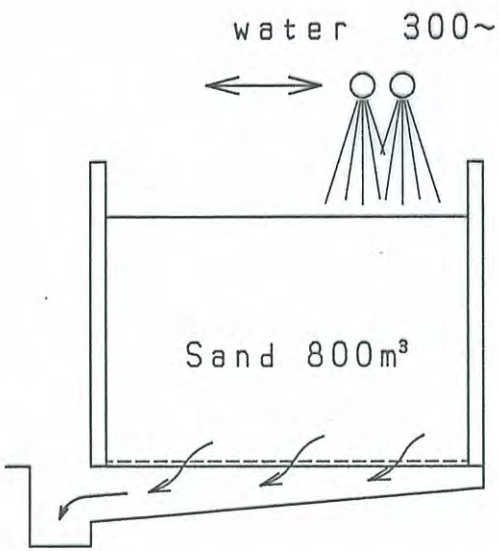
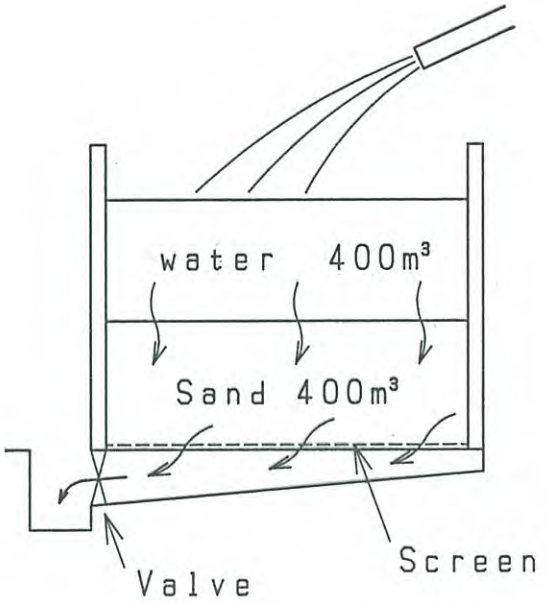
Procedure	(1)Sprinkler method  Cycle time : 10h	(2)Water dipping méthod  Cycle time : 12h~24h
Product	Nacl content < 0.02%(weight)	

Fig. 14 On shore desalting facility(Example)