Technical Manual

EBARA All Mighty Pump Model SAL

Contents

What is All Mighty Pump ?

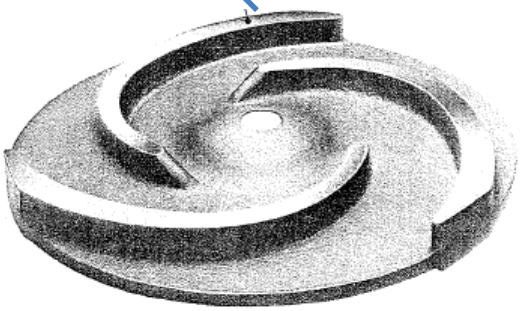
When using pumps, if the liquid contains particle matter like earth and sand, general purpose water pumps and stainless steel pumps would have troubles such as getting hole on casing/cover or getting clogged in impeller within short time, and it causes little discharge flow or even no discharge flow at all.

This is because those pumps are designed for water or chemical liquid, and they are not intended to apply for the liquid containing particle matter.

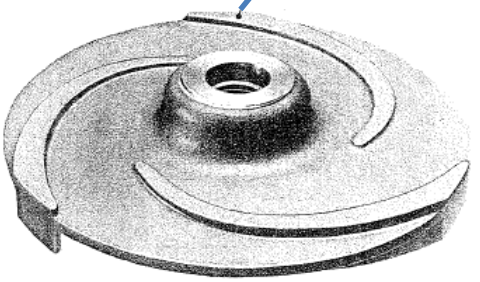
EBARA All Mighty Pump was developed to respond to the need "to handle solution mixed with liquid and particle matter such as earth and sand".

As this pump can be applied for all services except clear water, it makes a wide range of applications possible without care for trouble.

Main impeller vane



Rear impeller vane



Features of All Mighty Pump

■Features on construction
(refer to P3 Construction of All Mighty Pump)

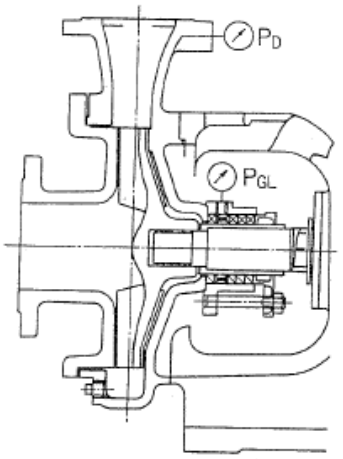
- Particle can be discharged without getting clogged due to semi-open impeller.
- No rust on shaft occurs, as shaft sleeve made of stainless steel is employed at packing part..

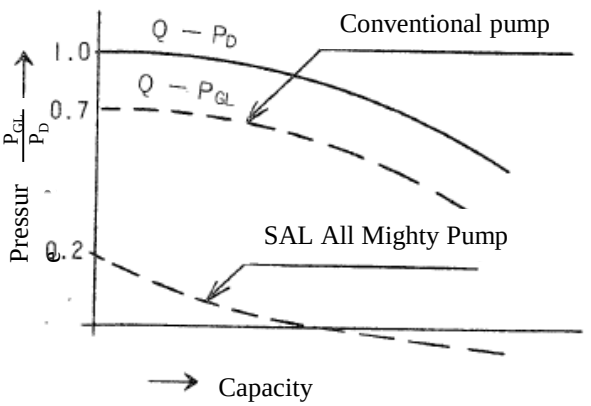
- By powerful rear impeller vane function, pressure is reduced so that pump discharge pressure PD is not put at gland. Also, it keeps particle matter like slurry in liquid from entering into gland during pump operation.

As a result, following merits are offered.

1. Minimal leakage from gland.
2. Sealing water (external flushing water) with low pressure and small flow.
3. Long life due to less wear on packing and sleeve.

4. Long life due to less strain on bearings by less shaft thrust.





P_D Pump discharge pressure
P_{GL} Discahrge pressure at gland during opeartion
(reduced pressure by rear impeller vane)

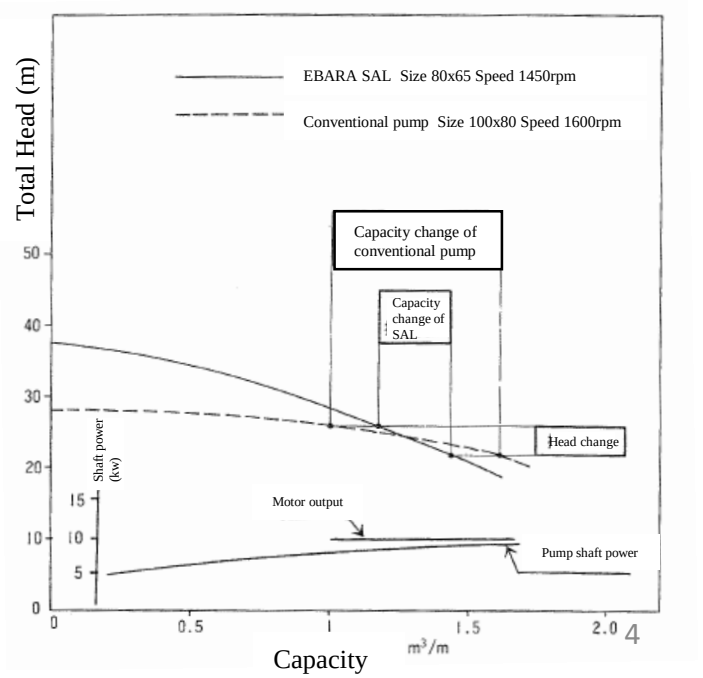
■Features on materials
(refer to P6 Q1 and P9 Materials of main parts)

- Special wear-resistant cast iron (EBARA brand: EBAREX) which was developed by EBARA is skillfully used for casing, suction cover and impeller. For example, for impeller which needs most wear resistance, EBAREX-H which has approx. 20 times of conventional cast iron in wear resistance is used, and for casing and suction cover which has less strain of wear, EBAREX-L which has 3 - 5 times of conventional cast iron in wear resistance.

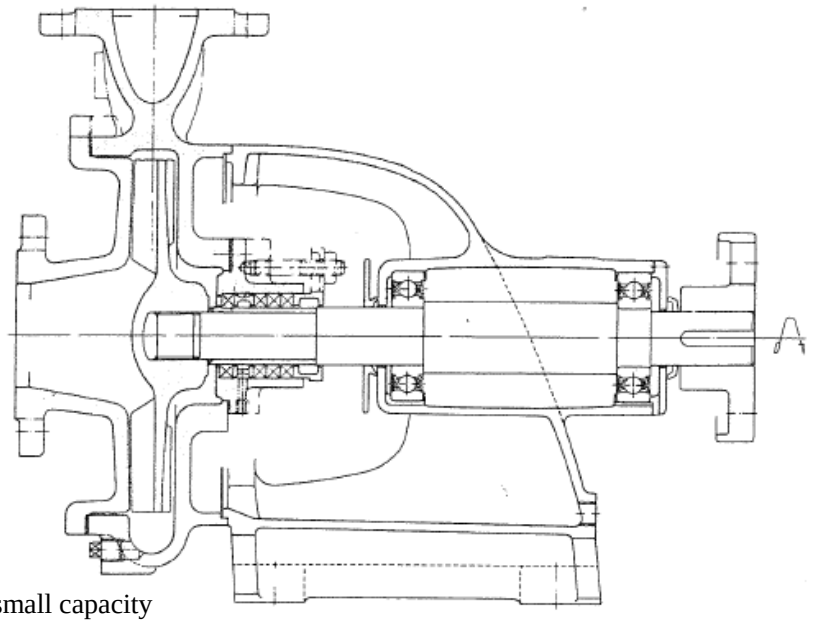
- In case that the site condition requires corrosion resistance as well as wear resistance, EBAREX-S is available EBAREX-S is two-phase stainless casting and interchangeable to standard (EBAREX-H, L), and it is more or less similar to SCS-16 in corrosion resistance and to EBAREX-L in wear resistance

■Features on performance

- Specially designed impeller with a limit load feature is used so that there is never a power overload no matter what the flow capacity.
- In addition to motor direct-driven type, V-pulley type is also provided for high total head.
- Pump performance shows gentle curve down to right so that head change does not affect so much to capacity change.

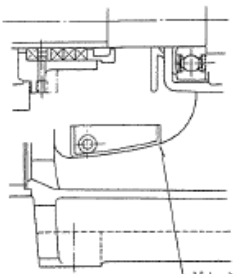


■Construction of All Mighty Pump (E, F, G type and H, J type)

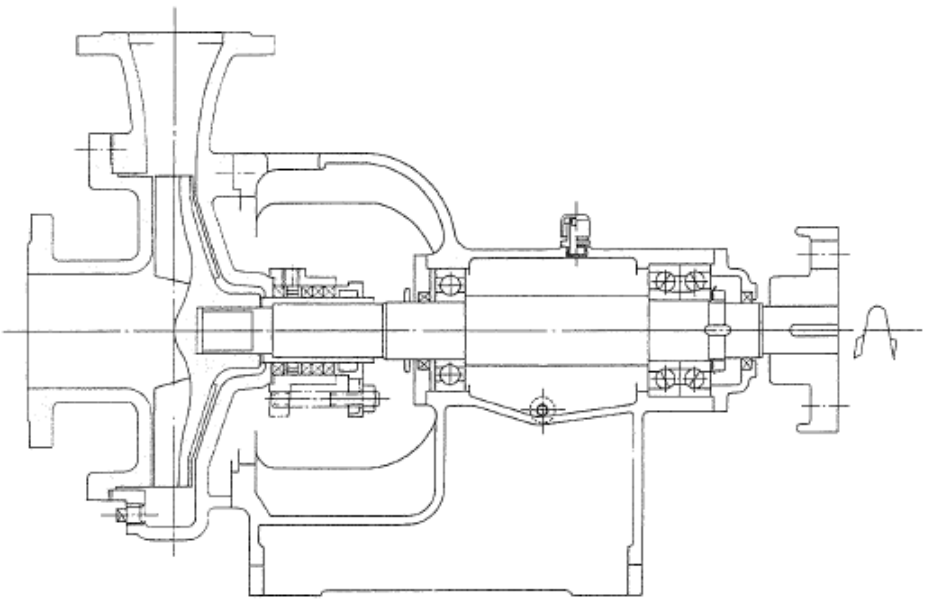


Low head, small capacity
(SAL - E, F, G)

Two-phase stainless casting



Drain receiver



High head, large capacity
(SAL - H, J)

■Comparison of construction between low head type and high head type

Item	E, F, G type	H, J type
Drive	Motor direct	Motor direct, Pulley
Sleeve gasket	O-ring	Teflon sheet
Shaft	SUS403	S35C
Shaft sleeve	Cylindrical sleeve	Abutting joint type sleeve
Splash ring	Rubber	SUS316
Bearing lubrication	N/A (Sealed ball bearings)	Oil bath
Oil seal for bearing cover	N/A	Oil seal
Bearings	Deep groove type sealed ball bearings	Deep groove type, Angular contact type

II. How to select / how to use SAL All Mighty Pump

1. How to select.

There are counteless kinds of solution mixed with liquid and particle matter called as slurry.

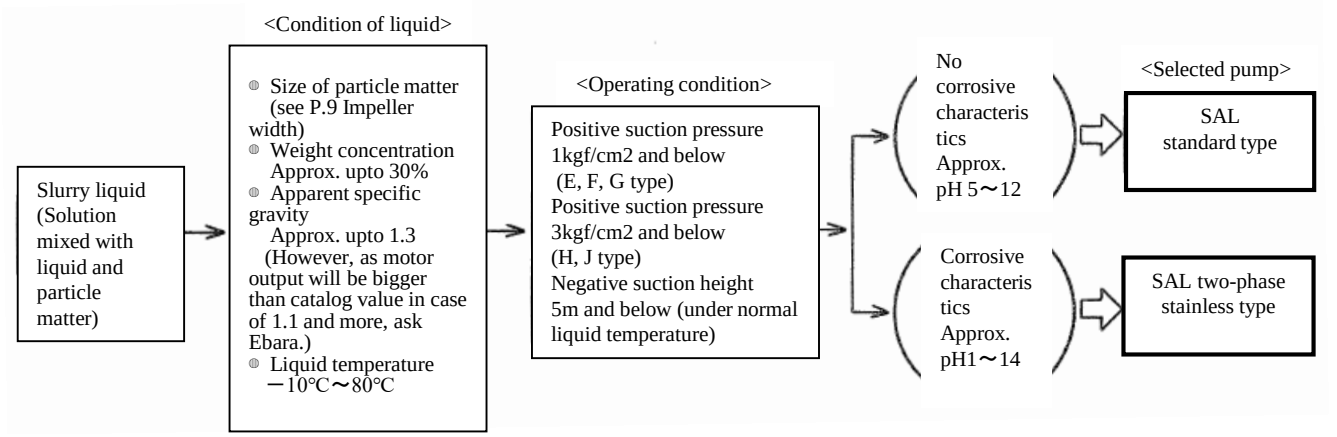
Therefore, proper pump is not selected by knowing of capacity and head only.

However, detailed review on solution may not be efficient, and practically there would be little case to get proper pump selection considering site condition.

Accordingly, rather than pursuing solution deeply, knowing of features of All Mighty Pump is most essential. To try to bring out the real strength of All Mighty Pump is the nearest way towards smart way of selection and usage of All Mighty Pump.

When selection of All Mighty Pump is checked in accordance with following chart, proper selection would be made efficiently without mistake.

■Selection flow of All Mighty Pump



2. How to use.

① To stir liquid

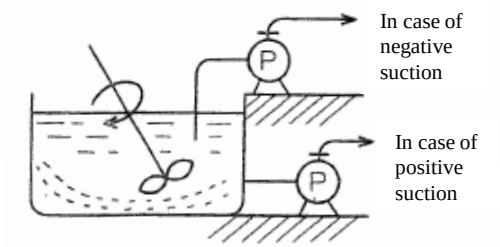
Although usage of All Mighty Pump does not change from general purpose pump, in case tha liquid contains much particle matter (high concentration) and heavy particle matter (large real density), to stir liquid before pump suction would result in less trouble.

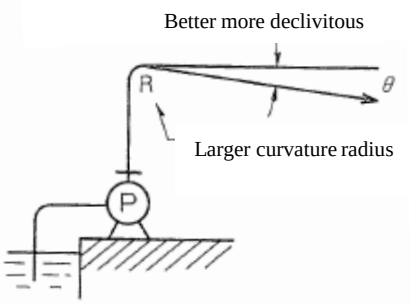
② To install pipe in simple manner

Both suction and delievery pipes should be installed in simple manner without bend and reduction/expansion so that clogging of particle matter or holing by wear could be prevented.

③ To use valve as little as possible

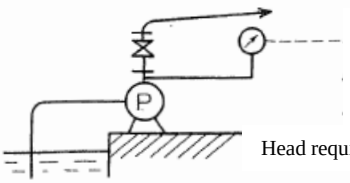
Do not use sluice valve ect. to regulate capacity. It will cause to shortage of life by wear and result in block in the piping. When valve is installed in case of slurry, it could be used for shut-down for disassembly/assembly.





■Countermeasure in case of excessive capacity.

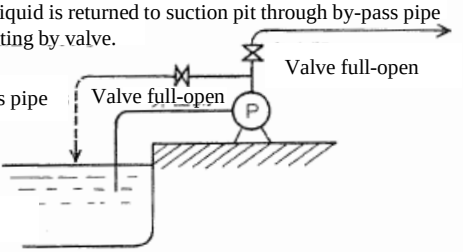
① By knowing of head actually required at site, check capacity of the pump..



Gauge pressure at valve full-open is the pressure (head) actually required at site.

$$\text{Head required (m)} = \frac{\text{Gauge pressure (kgf/cm2)}}{\text{Compound specific gravity}} \times 10$$

② Excessive liquid is returned to suction pit through by-pass pipe without regulating by valve.



III. Operation of All Mighty Pump in case of negative suction (Foot valve method, Self-priming tank method)

When pump starts, pump does not suck water, unless there is full liquid inside of pump and suction pipe.

Pump can continuously suck and discharge water because inside of pump and suction pipe becomes vacuum condition and atmospheric pressure pushes water into pump when pump operates and tries to discharge water. Water is continuously sucked and discharged by this continuous operation of pump.

In case of negative suction, equipment to be used for filling water inside of pump and suction pipe is required before starting pump. For All Mighty Pump, either foot valve or self-priming tank is used for this equipment.

■Using self-priming tank (EBARA self-priming tank = Under Utility Model Act application in Japan)

In case that foot valve can not be used due to much mixed earth and sand, use self-priming tank.

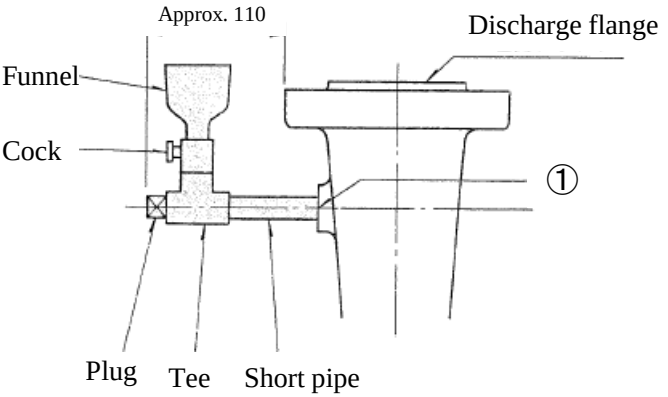
Advantage of using self-priming tank is almost no trouble at all due to simple construction such as no valve at pump suction side.

■Using foot valve

Foot valve could not be operated by lugging earth and sand between valve and valve sheet.

Therefore, foot valve with lever is recommended so that lug is released by shaking off from ground.

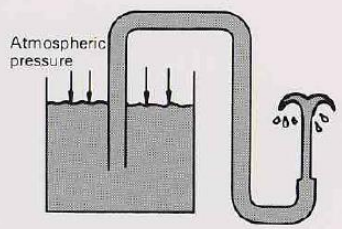
As standard pump is plugged at part ①, fix priming funnel by taking plug out.



● Principles of Self-Priming: Pumping by means of siphon action

Once the pipes are filled with water (a variety of methods can be used to do this) pumping will be sustained naturally. When the water in a section of piping beings to drop, a vacuum is created at the upper end of the pipe. The atmospheric pressure on the surface of the water in the water tank forces water in the tank up into the pipe so that it is once again full of water. (In a vacuum, atmospheric pressure has enough power to push water up 10 meters.) This is why pumping is sustained when the pipes are full.

If the pipe that is in the water tank is punctured, air will enter through the hole making siphoning impossible and forcing pumping to stop.



● How to Use the Self-Priming Tank

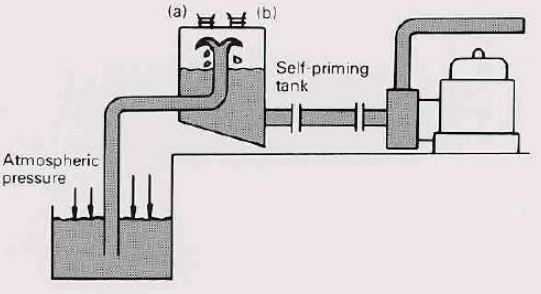
1 Open the air release valve (a) and the feed-water valve (b) and fill the tank with water.

2 After the tank has been filled to the point where water overflows from the top of the suction pipe, close valves (a) and (b) and start the pump.

3 As the water in the tank is sucked up by the pump, its level will gradually drop and the pressure level in the tank will also drop. However, once pressure has dropped to a certain point, the same siphon principle operates. The water in the water tank on the suction side is pushed by atmospheric pressure into the tank.

4 Therefore, when a pump is operated with a self-priming tank there is no need for a foot valve. When the liquid pump contains slurry, the foot valve seat is often worn to the point where it no longer functions and it becomes impossible to operate the pump. With an EBARA Self-priming Tank, however, this sort of trouble will never arise.

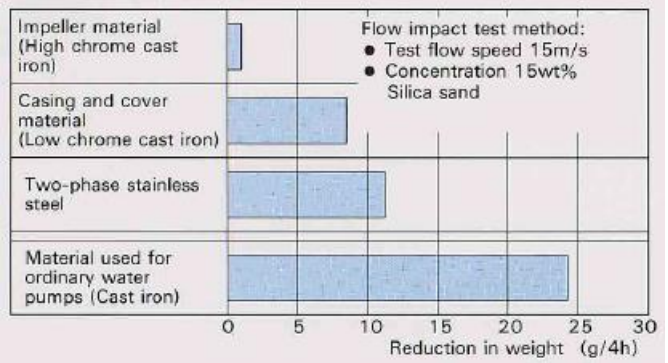
5 Even when the pump is stopped, all water in the tank will not drain which means it is possible to start the next pump operation without any preparation. Note, however, that if the tank is punctured or suction piping is damaged, self-priming will no longer be possible and the pump will not be able to function.



IV. Q&A of All Mighty Pump

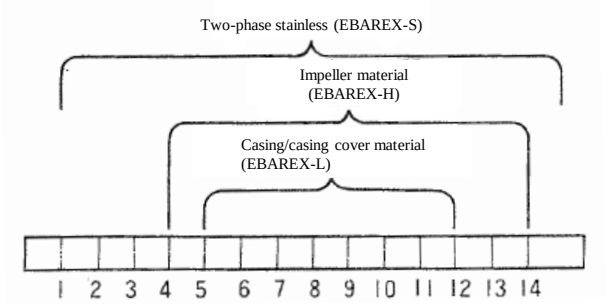
Q1. How strong are the materials of SAL All Mighty Pump against corrosion and erosion ?

● Comparison in wear resistance

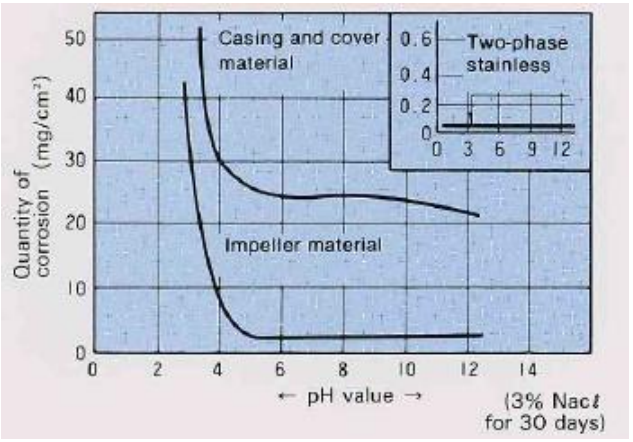


- For impeller which needs most wear resistance, high chrome casting (EBAREX-H) ,which is by far the best in wear resistance, is used. (approx. 20 times of conventional cast iron in wear resistance)
- For casing etc. which has less strain of wear, chrome casting (EBAREX-L), which is superior in wear resistance, is used. (3 - 5 times of conventional cast iron in wear resistance)
- In case that the site condition requires corrosion resistance as well as wear resistance, special two-phase stainless casting (EBAREX-S) is available.

● Corrosion resistance comparison

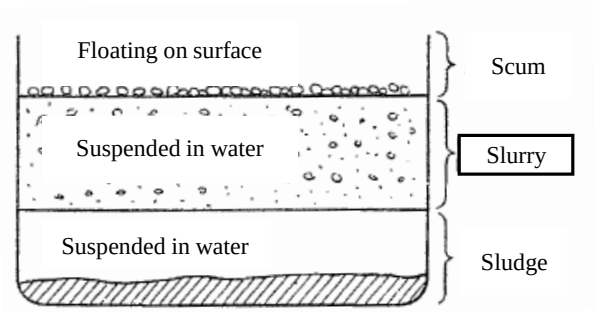


pH value and applicable range of SAL All Mighty Pump with EBAREX



Q2. What is slurry ?

Slurry is the muddy solution mixed with liquid (water as example) and particle matter such as earth and sand. The pump, which handles this kind of mixture of solid and liquid, is called "Slurry Pump".
By particle size handled, slurry pump is distinguished from sand pump and gravel pump in some case..



Q3. What is compound liquid specific gravity (apparent specific gravity) ?

In case of solution mixed with liquid and particle matter such as earth and sand, the specific gravity of liquid itself (mother liquid specific gravity) looks bigger arrarently due to the specific gravity of particle matter itself (true solid specific gravity) mixed and the quantity of mixture. It is called as "Compound specific gravity“ or "Apparent specific gravity".
It should be remarked that this specific gravity redoubles pump shaft power similar to the specific gravity of liquid only.
(Note) For calculating compound specific gravity (apparent specific gravity), see Page 8 Specific gravity of solids and Simple calculation chart.

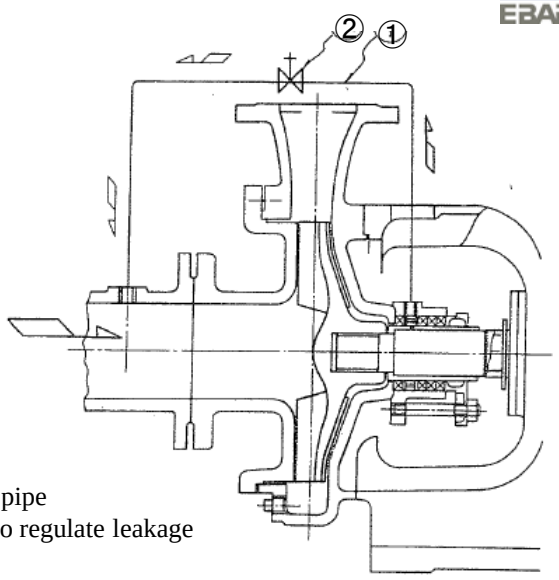
Q4. How is the slurry concentration described ?

There are few methods to describe the mixture ratio of solution mixed with liquid and particle matter.
1. To describe with weight ratio (weight concentration)
2. To describe with cubic volume (volume concentration)
3. To describe with weight of particle matter (g) in solution 1 litter

It should be noted that the compound specific gravity differs from each other, if the method to describe the mixture ratio is different, even though the mixture ratio value itself is same.

Q5. What is apparent viscosity ?

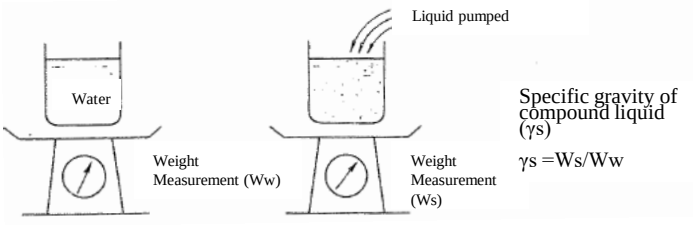
Generally oil is thicker than water, and oil has higher viscosity than water. However, in case that particle matter is mixed with water, if particle is smaller and mixture quantity is more, solid-liquid mixture solution looks higher viscosity.
It is called as "apparent viscosity" in distinction from viscosity of general liquid only such as oil.
As this viscosity affects intricately on reduction of pump performance in contrast to viscosity of oil,
in case that the liquid handled has high concentration, consult with EBARA.



① Return pipe
② Valve to regulate leakage quantity

Q6. How to measure compound specific gravity at pumping site ?

Measure weight of water and liquid in same quantity shown as follows.



Q7. How to do in case that no external flushing is available ?

Although external flushing is ideal for pump life, there may be the cases that external flushing could not be available because of characteristics of liquid or site condition, such as,

- In case that the liquid should not be diluted by external flushing, such as thickened sludge.
- In case that the liquid should not be mixed with other liquid or water.
- In case that external flushing is not available as site condition.

Before considering mechanical seal, it would be suggested to consider following method as the second best.

1. To return leaked liquid to suction side. (see figure)
2. To plug. This is not applicable for high negative suction (3m and more).
3. To use special mechanical seal. (consult with EBARA)

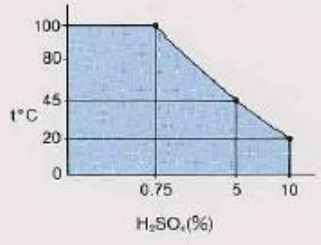
Q8. What is Two-phase stainless casting ?

Two-phase stainless steel is composed of austenite with a 40 to 60 % ferrite content. The principle features of each-the superior corrosion resistance of austenite and the hardness and strength of ferrite-have been skillfully combined. This two-phsae stainless steel can be used without the problems of conventional steels such as wear, corrosion, and cracking and is especially suited for use with sea water.

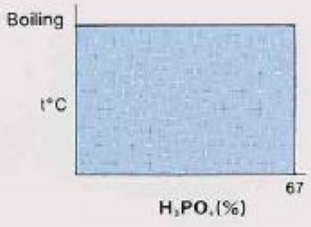
(Example of Corrosion Resistance)

Sulfuric Acid

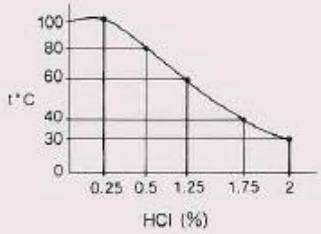
H_2SO_4: containing 1000 ppm chloride



Phosphoric Acid



Hydrochloric Acid



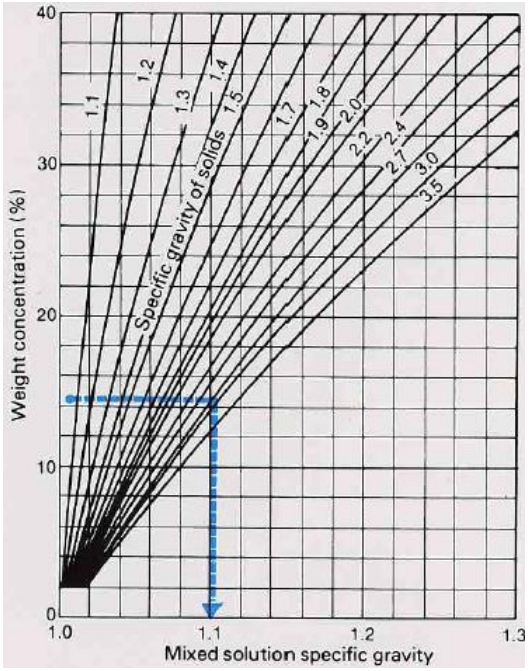
Note:
1. Shaded portion indicates approved limits.
2. Two-phase stainless steel corrosion resistance is nearly the same as that of SCS-16 and its wear resistance is nearly the same as low-chrome cast iron.

V. How to calculate compound liquid specific gravity (apparent specific gravity) for EBARA Slurry Pump

■Specific gravity of solids

Material	True specific gravity
Andesite sand	1.5
Sandstone sand	2.05
Tuff	1.5～2.0
Marble	2.68
Granite	2.65
Dolomite	2.6～2.9
Lime stone	2.7～3.0
Quartz, Rock crystal	2.65～2.7
Calsite	2.7
Nepheline	2.93
Shale slag	2.58
Sand (size 2 ~ 0.05mm)	2.61～2.8
Silt	2.7
Clay	2.5～2.9
Fumus earth	1.37
Turfy earth	1.26～1.46
Gravel	2.61 ~ 2.68 (Ave. 2.65)
Cement	2.7 ~ 3.2 (Ave. 3.0)
Cement raw material	2.7
Glass	2.2～6.0
Soda lime glass	2.5
Sulphide	3.3
Diatomaceous earth	1.92
Saliceous terra alba	2.17
Alunite slag	2.41
Calcium oxide	3.4
Concrete	2.3
Brick	2.0～5.9

Material	True specific gravity
Coal	1.3～(2.0)
Anthracite	1.5
Coal waste	2.0～2.7
Mica	3.0
Sulpher	2.1
Charcoal	1.4～1.9
Boiler waste	2.0～2.5
Fly ash	2.04
15% Ferrosilicon	6.8
Bauxite	2.5
Limonite	3.7
Chrome iron ore	4.3
Magnetite	5.2
Hematite	5.2
Iron sand ore	2.7～(3.0)
Pyrite	4.2
Cuprite	6.0
Cupreous ore	3.5
Cupreous slag	2.5～2.63
Tin stone	6.8
Earth bitumen	1.1
Apatite	3.1
Gypsum	2.3
Paper fiber	1.0
Live fish	1.0
Galena	7.5
Lead	11.3



■Simple Calculation Chart

(for calculating compound specific gravity on basis of specific gravity of solids and weight concentration.)

(Example)

The liquid is silt and has a weight concentration of 14.5%. You want to find specific gravity of the mixed solution.

1. Determine specific gravity of silt by referring to chart listening specific gravity of solids.
2. Using the Simple Calculation Chart at left, draw a horizontal line at the point where weight concentration is 14.5%. Draw a vertical line down from the point where the horizontal line intersects with the 2.7 specific gravity curve.
3. This gives a mixed solution specific gravity of 1.1.

VI. Technical data of All Mighty Pump

■Principal dimensions of SAL

Size	Type	Output (kW)			Impeller (mm)			Sleeve outer dia	Bearings			Gland			
		60Hz	50Hz	Belt-driven	Outer dia 60Hz	Outer dia 50Hz	Width		Thrust	Radial	Oil (lit.)	Packing size x pc.	Box size Ext. x Int. x depth	Flush. L/min	Flush. Pres. Kgf/cm^2
40x32	E	0.75			172		8	35	6306ZZ	6306ZZ		8x4	51x35x48	2～3	1.0
	F	1.5	0.75		202	202	8								
50x40	E	1.5	0.75		188	188	9.5	35	6306ZZ	6306ZZ		8x4	51x35x48	2～3	1.0
	F	2.2	1.5		207	207	9.5								
	G	3.7	2.2		244	248	8		6307ZZ	6307ZZ					
65x50	F	3.7	2.2		236	236	10	45	6309ZZ	6309ZZ		10x4	65x45x58	2～3	1.0
	G	5.5	3.7		266	270	10								
	H	7.5, 11	5.5	2.2～18.5	298, 330	320	10	55	7310BDB	6309ZZ	0.4	10x4	75x55x62	3～5	2.0
80x85	F	5.5	3.7		247	247	16	45	6309ZZ	6309ZZ		10x4	65x45x58	2～3	1.0
	G	7.5	5.5		266	272	16								
	H	11～18.5	7.5, 11	3.7～30	292,316,330	306, 330	16	55	7310BDB	6309	0.4	10x4	75x55x62	3～5	2.0
125x100	H	11～18.5	7.5, 11	3.7～18.5	230,252,264	244, 264	32	55	7310BDB	6309	0.4	10x4	75x55x62	3～5	2.0
	J	22, 30	15, 18.5	22～37	300, 324	310, 324	24	70	7313ADB	6312	0.8	12.5x4	95x70x72		
150x125	H	22～37	15～22	11～45	max.270	max.270	48	70	7313ADB	6312	0.8	12.5x4	95x70x72	3～5	2.5
	J	37～55	22～37		max.330	max.330	41								
200x150	J	45～90	37～75	15～75	max.330	max.330	60	90	7318BDB	6316	1.4	14.5x4	119x90x90	5～8	2.5

■Materials of main parts of SAL

SAL All Mighty Pump uses well 3 kinds of alloy for appropriate parts.
Following charts show standard chemical composition and mechanical characteristics of 3 kinds of alloy.

Chart - 1 Standard chemical composition of EBAREX alloy

	C	Si	Mn	Cr	Ni	Mo	Other	Applicable parts
EBAREX-L ※ (Chrome casting)	2.8～3.2	1.8～2.2	0.5～0.7	0.4～3.0	-	-	Special element	Casing, Suction cover
EBAREX-H (High chrome casting)	2.3～3.0	0.5～1.5	≦1.5	24.0～30.0	-	-	-	Impeller
EBAREX-S ※ (Two-phase stainless)	＜0.10	＜1.50	＜1.0	23.0～27.0	5.00～7.00	1.50～2.50	Special element	Casing, Suction cover, Impeller made of Two-phase stainless

(* Patent pending)

Chart-2 Mechanical characteristics of EBAREX alloy

	Tensile strength (kgf/mm^2)	0.2% Proof stress (kgf/mm^2)	Transverse rupture load (kg)	Deflection (%)	Elongation (%)	Hardness (HB)
EBAREX-L	25～35	-	≧1,000	≧5.0	-	250～350
EBAREX-H	50～70	-	≧1,000	≧1.2	-	550～650
EBAREX-S	＞65	＞40	-	-	＞25	250～350

VII. Applications of All Mighty Pump

As explained previously, All Mighty Pump is really "All Mighty" pump which was developed to handle 「solution mixed with liquid and particle matter such as earth and sand」.

By using together with self-priming tank, this All Mighty Pump can handle many applications as follows

1. Where standard pump (with foot valve) is applied and gets in trouble.
   (There are many cases where foot valve does not function properly or in trouble, and where pump proper is worn.)
2. Where self-priming pump is applied and gets in trouble.
   (There are many cases where operation is less efficient due to long priming time, where suction check valve gets trouble, and where pump proper is worn.)
3. Where submersible pump is applied and gets in trouble.
   (There are many cases where frequent trouble in mechanical seal happens due to earth and sand, and where pump proper is worn.)
4. Where vertical pump is applied and gets in trouble.
   (There are many cases where frequent repair/inspection is required due to wear of submerged bearings.)

■Applications where Ebara model SAL All Mighty Pump is used.

(SAL All Mighty Pump is ideal for transfer, drain and circulation of water/oil mixed with particle matter such as earth/sand and cement powder.)

● Chemical Industry

- Neutralizing agents (milk of lime)
- Filter press supply liquid (water with high mud concentration)
- Residual filter sediment (water with high mud concentration)
- Wet type dust collection (dust-impregnated water)
- Sediment disposal (drains)

● Metal/Mining

- Waste liquid (ore/mud-mixed water)
- Filter press supply liquid (water with high ore/mud concentration)
- Pit drains (earth/sand-mixed water)

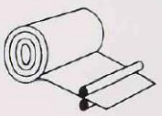
● Oil Refining

- Waste disposal (noncorroded waste)
- Pit drains (water with soft mud)

● Cement/Concrete

- Milk of lime (lime-water mix)
- Used ready-mix concrete wash water (concrete/gravel-mixed water)
- Equipment drainage

● Paper & Pulp



- Pulp treatment (max 4% concentration)
- Additives (clay-mixed water)
- Neutralizing liquid (milk of lime)
- Waste disposal (sediment-mixed water)

● Water Works & Drainage

- Sludge transport (water with high sludge concentration)
- Filter press supply sludge (water with high sludge concentration)
- Settling tank drainage (water with high sludge concentration)
- Concentrating tank drainage (sludge-mixed water)

● Foods

- Kitchen drains (filtrate)
- Waste liquid disposal

● Pottery Manufacturing

- Kaoline (Kaolin-mixed water)
- Grinding plants (residual water drainage)

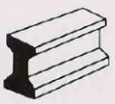
● Sugar/Salt Manufacturing

- Used wash water (earth and sand-mixed water)
- Steamed and boiled liquid (molasses)

● Constructing/Quarrying

- Dredging (water mixed with sand and gravel)
- Mud water drainage (earth and sand mixed water)

● Steel Manufacturing & Refineries



- Used coke cooling water (mixed with coke dust)
- Casting sand recovery (water mixed with sand)
- Conveyor pit drainage (water mixed with iron oxide)
- Residual settling tank liquid (water mixed with sludge)
- Dust collecting circulating liquid (dust mixed water)

● Motor car/Machinery Industries

- Paint disposal (paint mixed water)
- Used grinding liquid disposal (oil-liquid mixture with grinding sand dust)
- Used cutting oil disposal (oil mixed with chips)
- Wash water circulation (liquid mixed with chips, grindstone dust)

● Thermal Power Stations

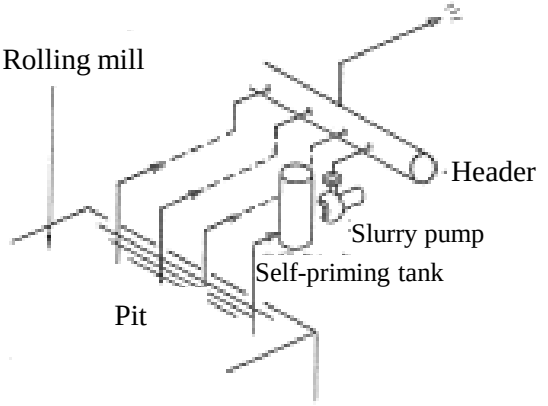
- Incinerator ash disposal (water mixed with ash, carbon)
- Dust disposal (dust-mixed water)

● Fisheries

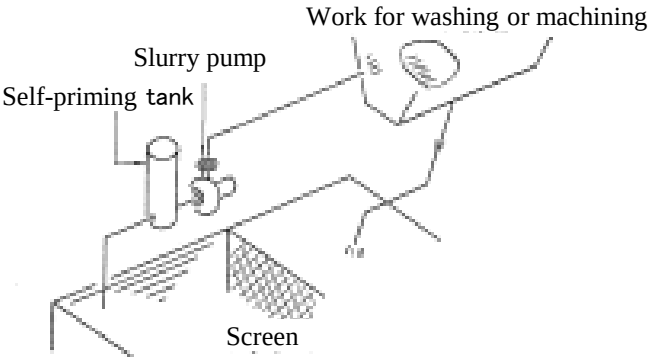
- Fish and shellfish disposal (boiled down liquid)
- Farming (sea water mixed sand)

■Concrete examples of usage

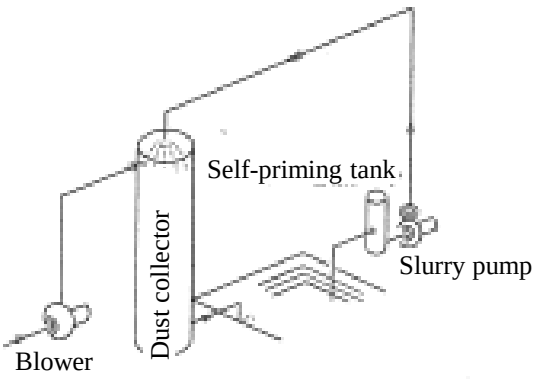
● Steel manufacturing
Scale pit drains at rolling mill.



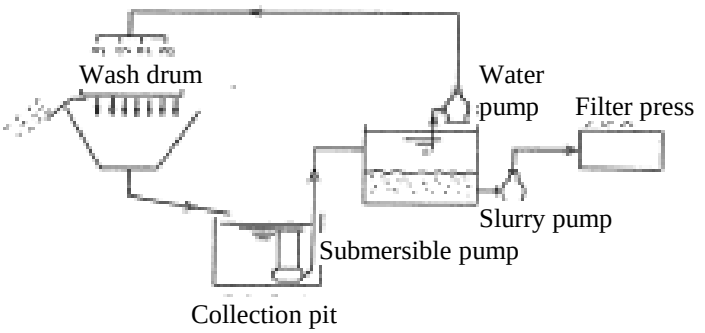
● Motor vehicle / Bearings
Circulation of cutting oil, grinding liquid and wash water.



● Casting foundry
Liquid circulation for wet type dust collector

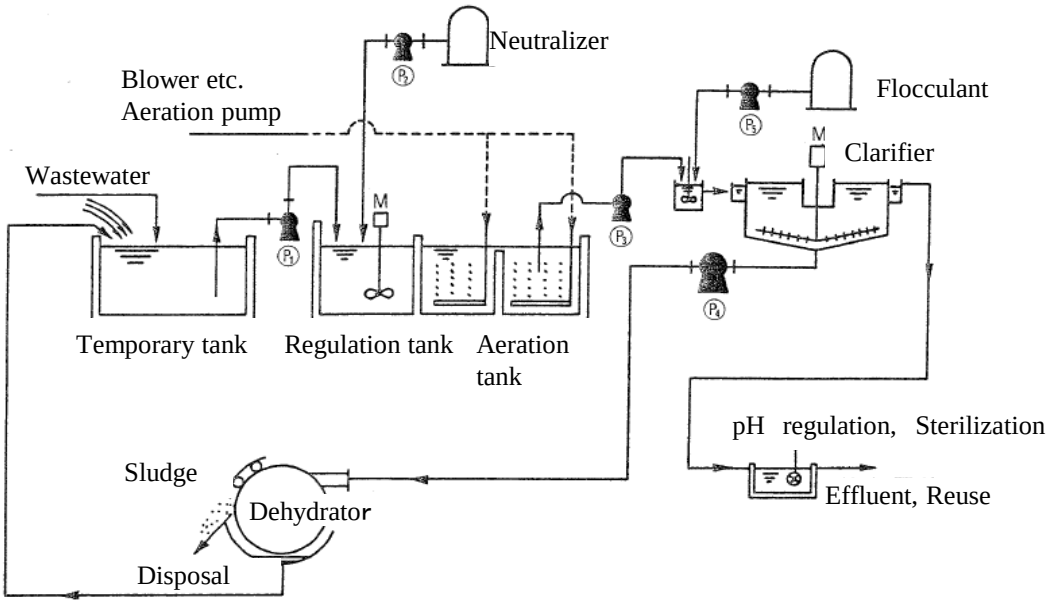


● Crushing plant
Washing gravel at gravel pit



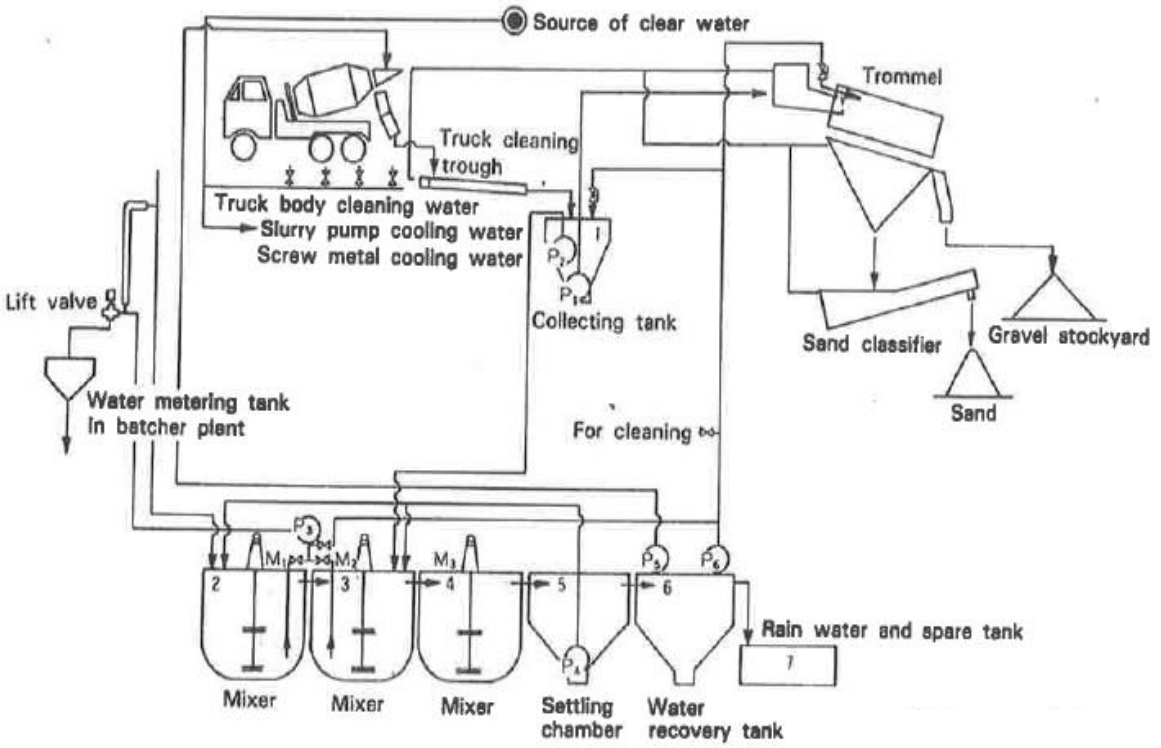
■Concrete examples of usage

● Wastewater treatment (Cannery, Dyeing/Weaving plant)



Application	Pump type	Applicable EBARA model
P_1 Raw water pumping	Non-clog pump	ULK, DV
P_2 Neutralizer (lime milk) mixing	Wear resistance pump (Slurry pump)	SAL
P_3 Activated sludge (slurry) transfer	Ditto	SAL
P_4 Sludge draw, filter press supply sludge	Ditto	SAL, URSD R/L, URSD M/L
P_5 Polymer flocculant supply	Dosing pump	URSD R/L

● Concrete plant



Application	Pump type	Applicable EBARA model
P_1 Trommer supply pump	Wear resistance pump	SAS (depending on plant, SAS may not be applicable)
P_2 Aggregate tank lifting pump	Ditto	SAS
P_3 Batcher supply pump	Ditto	SAL
P_4 Sedimentation tank lift pump	Ditto	SAS
P_5 Truck wash pump	Self-priming pump	SQ
P_6 Wash pump	Ditto	SQ

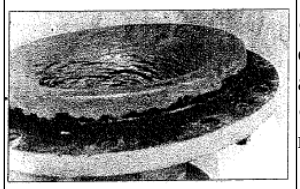
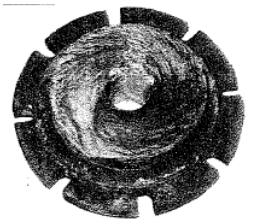
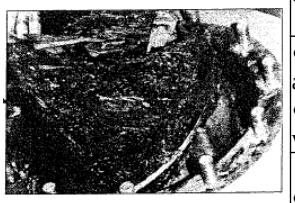
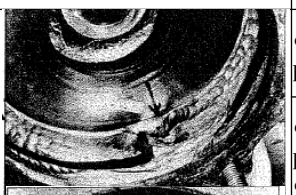
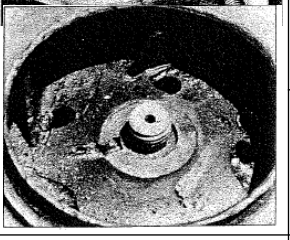
VIII. Troubleshooting of SAL All Mighty Pump

When handling「solution mixed with liquid and particle matter such as earth and sand」like SAL All Mighty Pump, following troubles and countermeasures could happen.

Trouble	Cause	Countermeasure
Pump does not discharge specified capacity.	★Worn, Corroded, Clogged. ★Performance reduction due to high concentration, high viscosity ○Excessive piping loss	See "Quick matrix chart" See "Quick matrix chart" Review plan and calculation
Pump does not discharge water at all.	★Clogged ○Too high suction height ○Too small pump capacity ○Inproper function of foot valve due to earth and sand ○Too small self-priming tank capacity ○Air suction	See "Quick matrix chart" Change installation location Review plan and calculation Change to self-priming tank method Review tank capacity Check connecting parts
Overload	★Clogged ★Performance reduction due to high concentration, high viscosity ○High compound specific gravity	See "Quick matrix chart" See "Quick matrix chart" Check compound specific gravity

★See Quick matrix chart of troubleshooting

IX. Quick matrix chart of troubleshooting

Cause		Visual condition of failure surface	Picture	Points to check	Countermeasure
Wear	Wear by particle matter ●High hardness of particle ●High compound ratio (concentration) ●Particle with sharp edge	Surface looks like being chiseled.		●If pump construction, type is appropriate. ●If proper pump material is applied.	●Review pump type, model. ●Review pump material.
	Wear by lugging particle matter ●Lugged between impeller and casing cover ●High concentration, high specific gravity ●Frequesnt start/stop	Grooves like record disk		●If clearance between impeller and cover is appropriate based on particle size. ●If start/stop is too frequent. ●If any abnormal noise arises.	●adjust clearance (approx. 0.5mm normally) ●Continuous operation ●Larger clearance
Clog	Clog by fiber ●Lots of long fiber	Fibers solidified at impeller inlet		●If pump construction, type is appropriate.	●Review pump type, model.
	Clog by solid matter ●Large and long solid	Tumbled at impeller inlet		●If flow channel size is appropriate. ●If pump can withstand shock.	●Review material, thickness, type and model.
	Clog by intermittent ●High concentration, high specific gravity	Grooves like record disk. Worn much at impeller edge		●If earth/sand deposited inside of casing when disassembly	●Continuous operation ●Review piping arrangement ●Review type, model, system
Corrosion	Corrosion by pumped liquid ●Two-phase stainless is suitable for pH5 and below	Moth-eaten appearance		●Check pH of liquid pumped	●Review material (Two-phase stainless)
	Corrosion due to unnetralized	Graphitized at corroded surface Locally corrosion failure		●Check treatment process ●Failure occurs in short period (1 week ~ 1 month)	●Review pump type, model. ●Review pump material.
	Mainly corrosion, secondly wear	Impeller becomes half in short period		●Slurry is mixed with corrosive mother liquid. ●Short life as 1 week ~ 1 month	●Review pump type, model. ●Review pump material.
High concetration High viscosity	Increase of arrarent specific gravity and viscosity due to high concentration	Insufficient capacity or overload at site		●Check fluidized condition of liquid	●Review pump type, model. ●Review pump material.