

Next Generations Technologies

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**English**

[www.ngst.co.kr](http://www.ngst.co.kr)

# Technologies of NGST

1

Micro-Bubble Generator  
No Power required Flotation Tank

CMG<sup>TM</sup>  
NPFT<sup>TM</sup>

2

Pipe Mixer and Flocculation  
Hydro Cyclone-Screen-Filter

PMF<sup>TM</sup>  
HCS  
Filter<sup>TM</sup>

3

Sludge Solubilization and Crystallization  
for Energy and Fertilizer

MixCa<sup>TM</sup>

4

Non-Point Source Pollution Control

IHS<sup>TM</sup>

5

River, Lake, Pond Purification  
Corrosive Wastewater Treatment

PP, PVC

6

Manufacture and Design Using  
CFD and 3D tool

Engineering  
& CFD

# 1. Micro-bubble and Flotation Tank



## Micro-Bubble Generator(CMG™)



## No-Power Required Flotation Tank(NPF™)

### CMG™ (Compact Micro-bubble Generator)

CMG is a device to generate a fine micro-bubbles. CMG is easily attachable and detachable to a existing equipment, so when it is installed on a wesco-typed pump, micro-bubbles are generated when the pump works.

### NPF™ (No Power-required Flotation)

NPF has various effective functions for floating pollutant including without power and facilities for removing scum.

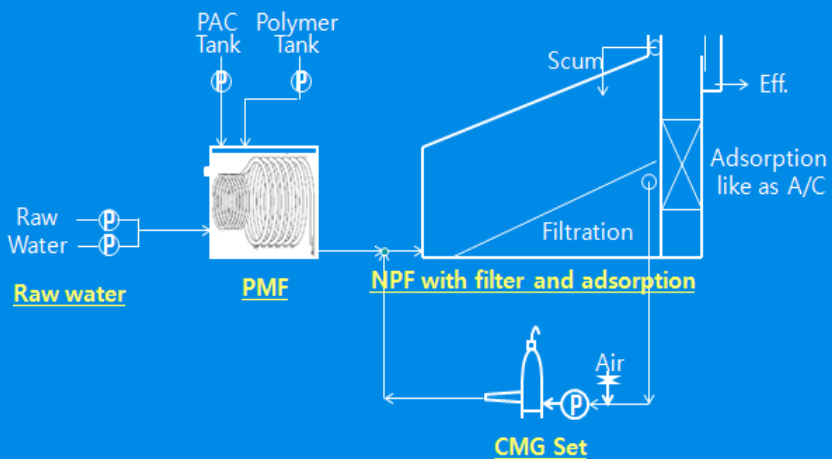


CMG-10hP for Sea Water(PP)



Case of CMG-10hP for Sea Water

## Livestock Wastewater treatment using CMG, PMF and NPF



- PAC : Poly aluminum chloride  
Polymer can be skip depends on concentration of raw water
- PMF : Mixing and flocculation using wound pipe.
- NPF : No-power requiring floatation tank  
Floatation-> Settling->Filtration->Adsorption
- CMG : Compact micro-bubble generator



## Specifications of CMG

Model	Flowrate(L/min)	Power(kw-hp)	In /out Dia(A)
CMG -0.2	5	0.2-1/4	15,15
CMG -0.4	10	0.4-1/2	20,20
CMG -0.75	17	0.75-1	20,20
CMG-1.5	32	1.5-2.0	25,25
CMG-2.2	40	2.2-3.0	25,25
CMG-3.7	55	3.7-5.0	32,32
CMG-5.5	100	5.5-7.5	50, 2 inch
CMG-7.5	130	7.5-10	50, 2 inch
CMG-11.0	300	11-15	80, 3 inch

- Product Material : More than at least STS316, PP and PVC for sea water

## Specifications of NPF

Model	Size(mm) L x W x H	Flow rate	
		m³/min	m³/hr
NPF - 10	1300 x 1300 x 2000	0.17	10
NPF - 25	2000 x 2000 x 2500	0.42	25
NPF - 50	3000 x 3000 x 2500	0.83	50
NPF - 75	3500 x 3500 x 2500	1.25	75
NPF -100	4000 x 4000 x 2500	1.67	100
NPF -120	4500 x 4500 x 2500	2.00	120
NPF -150	5000 x 5000 x 2500	2.50	150
NPF -200	8000 x 8000 x 3000	3.33	200
NPF -300	10000 x 10000 x 3000	5.00	300

- Product Material : More than at least STS316, PP and PVC for sea water

## 2. Pipe Mixer/Flocculater and Filter

- 1 Pipe Mixing and Flocculation Unit(PMF™)
- 2 Hydro-cyclonic, Screening & Filter Unit (HCS Filter™)



### PMF™ (Pipe Mixing and Flocculation Unit)

PMF is a rapid mixing and flocculation unit using various radius of curvature and sectional area of pipe lines without agitators and reactors. It can be used with HCS Filter, IHS and NPF for coagulation and flocculation.



### HCS Filter™ (Hydro-cyclonic, Screening & Filter Unit)

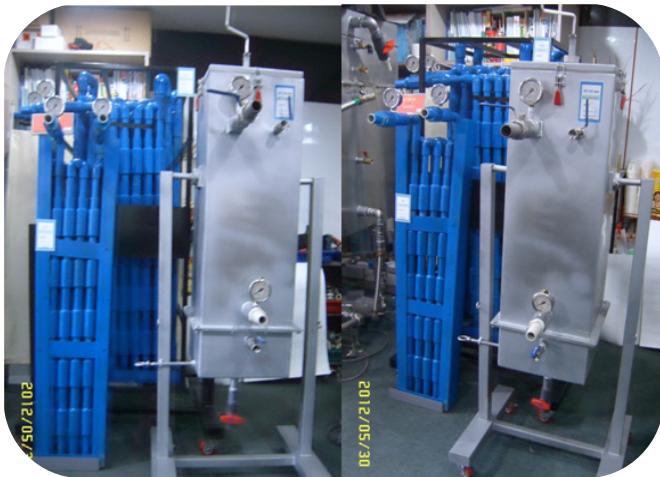
HCS is composed of a compact one unit with three processes-hydro cyclone, screening with auto-cleaning, and filtering. HCS will replace for huge sand filter and TP removal process in wastewater plant.



## Comparison NGST Technologies with Conventional Process

Hydraulic detention time of PMF and HCS Filter takes only 2 ~3 minutes while conventional Process-rapid mixing, flocculation, setting, and sand filter - takes 100~ 120 minutes.

Electric power of PMF and HCS Filter need only 1.0 ~1.5kW while it of conventional process need 20 ~30kW to treat 250 m<sup>3</sup>/day of polluted water. When you want to control a contaminated water, however if you can not use electricity, PMF and HCS Filter are able to treated it satisfactorily with only a small generator.



PM, PMF and HCS Filter for Q= 250 m<sup>3</sup>/day

PM : Pipe Mixer

PMF : Pipe Mixer and Flocculation Unit

HCS Filter : Hydro cyclone, Screening and Filtration Filter



## PMF Technology for 250 ton/day

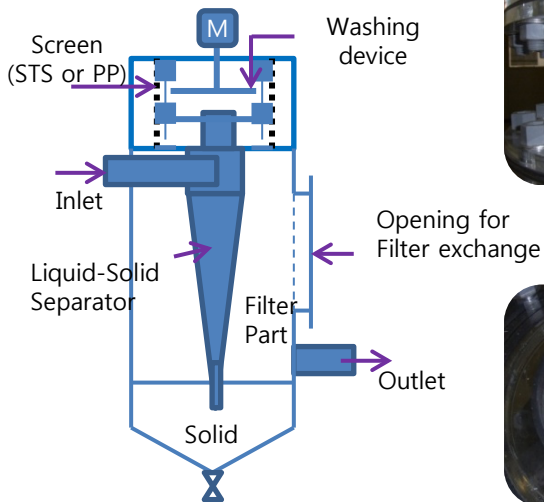
	Conventional chemical Treatment	PMF
Picture		
Area(m <sup>2</sup> )	3.5	0.2
Comparison	<ul style="list-style-type: none"> <li>- Need more than 3 reactors</li> <li>- Need Agitator and Motor</li> <li>- Need different kinds of agitator according to G values</li> </ul>	<ul style="list-style-type: none"> <li>- Almost Plug Flow Reactor</li> <li>- No need service because no moving parts</li> </ul>



PMF(Pipe Mixer and Flocculator)  
W500 x L500 x H1500(He 1200)



PM(Pipe Mixer)  
W300 x L100 x H 1200

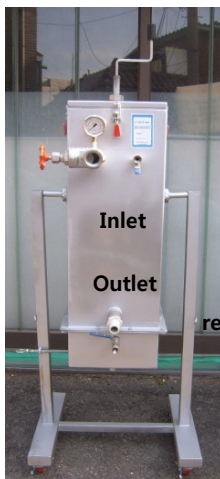


Part of Screen  
(STS304)

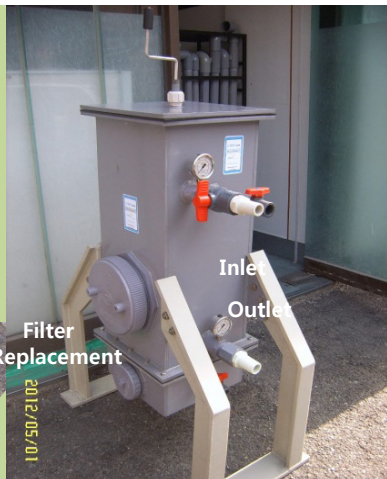


Cleaning Device  
for Screen

### HCS Filter Conceptual (Hydro cyclone, Screening, Filtering Unit)



**HCS Filter-500-ST304**  
: for wastewater, Lake, Pond



**HCS Filter-500-PP&PVC**  
: Sea water, Ballast water,  
Acid and alkali wastewater



## Processes for PMF and HCS Filter

Type	Process	Chemical Use	Explanation of Process
I	Raw water → HCS	No	Most high-Flow rate processing Most compact Rain water Harvesting, First Flush water, Pretreatment for R/O and U/F, Ballast water
II	Raw water → PM → HCS	Coagulant (PAC, Alum, etc)	High-Flow rate processing Remove for Phosphorus, Metals More compact Purification of Lake, Pond
III	Raw water → PMF → HCS	- Coagulant (PAC, Alum, etc) - Polymer	Remove for SS, Phosphorus, Metals Most water quality processing

## ● Unit Specifications

### I. Pipe Mixing and Flocculation, PMF

Model	Flow rate (m <sup>3</sup> /day)	Size	Materials
PMF-250	250	W 500 x L 1200 x H 450	STS, PVC, PP
PMF-500	500	W1000 x L 1800 x H 850	STS, PVC, PP
PMF-1000	1,000	W2000 x L 2300 x H 1200	STS, PVC, PP
PMF-2000	2,000	W2000 x L 3200 x H 1350	STS, PVC, PP
PMF-5000	5,000	W2000 x L 5500 x H 1500	STS, PVC, PP

- 1) This process has included functions of pH control, mixing and flocculation, cf) PM
- 2). Size will be different according to site conditions



## II. Hydro cyclone-Screening-Filter(HCS Filter)

Model	Flow rate(m <sup>3</sup> /day)	Size	Materials
HCS Filter-500	250 ~ 500	W 300 x L 300 x He 1000(1300)	STS, PVC, PP
HCS Filter-1000	500 ~ 1,000	W 400 x L 400 x He 1200(1500)	STS, PVC, PP
HCS Filter-2000	1,000 ~ 2,000	W 500 x L 500 x He 1500(1800)	STS, PVC, PP

Flow rate and water quality are able to be different with the presense of chemical, opening size of screen, Filters. This flow rate is based on screen opening 0.1mm.

## III. Screen

Micron	500	300	200	130	100	80	50
mm	0.5	0.3	0.2	0.13	0.10	0.08	0.05
Mesh	30	50	75	120	155	200	300

## IV. Filter

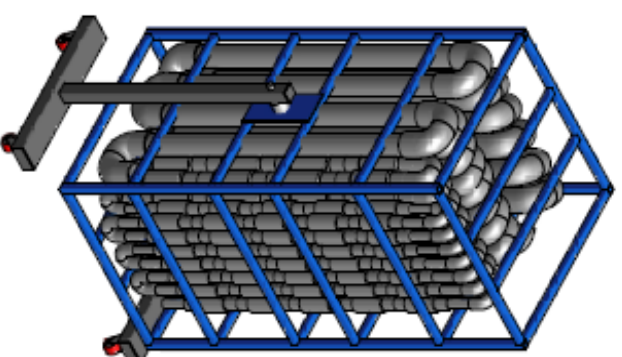
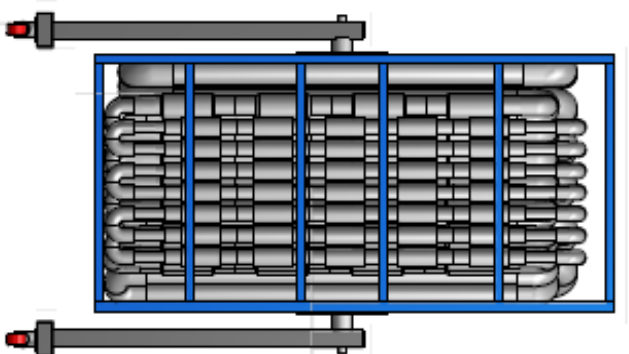
Materials	Contents
Nonwoven fabric	Cheaper and superior filtration capacity
Activate Carbon	Organics, Colors, Aromatic compounds, <b>Odors</b>
Slag	Filtration and Crystallization of Phosphorus
Zeolite	Removal for Ammonium
Lime	Removal for Ammonium
Disinfectant	Bacteria Removal
Composite media	Other filter media is configured by each depth depending on the purpose

## V. Power Consumption

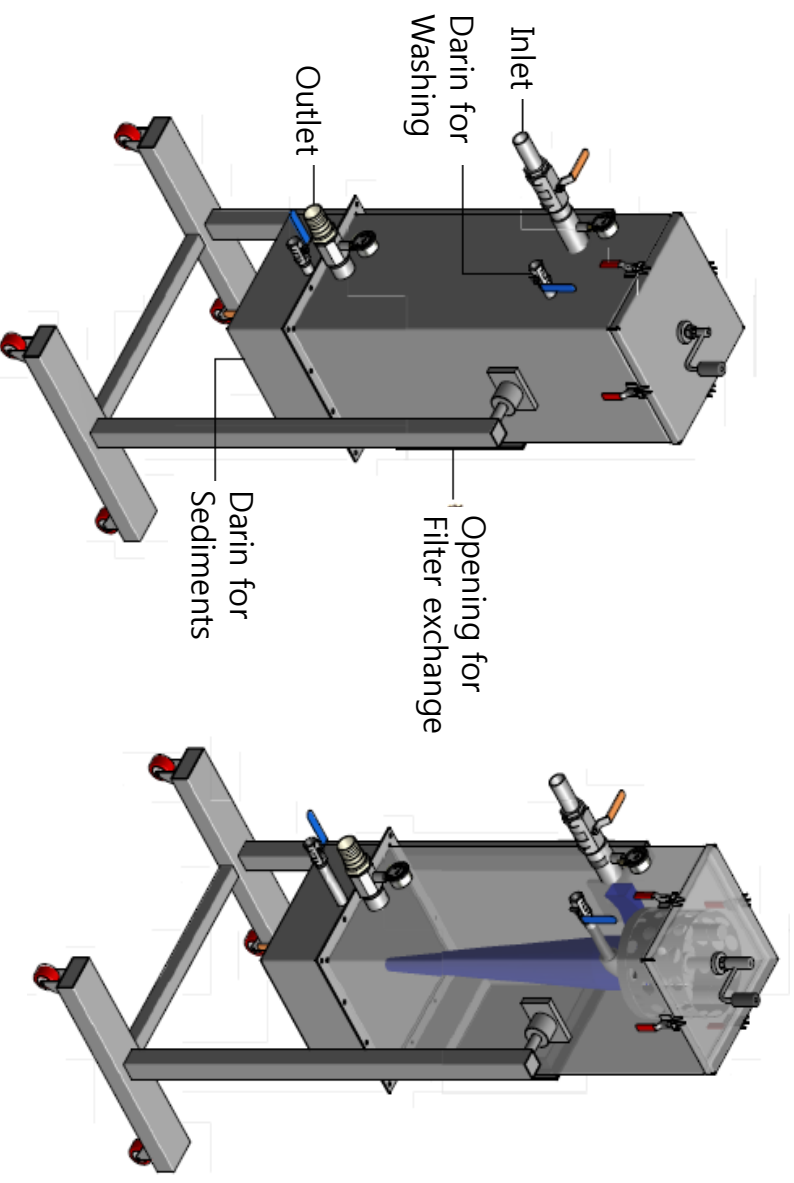
Flow rate (m <sup>3</sup> /day)	Submersible pump(kW)	Coagulant Feeder(W)	Polymer Feeder(W)	Power Consumption (kW)
250 ~ 500	0.25~0.50	30	30	0.25~0.56
500 ~ 1000	0.50~1.0	50	50	0.50~1.1
1000 ~ 1800	1.0 ~ 2.0	100	100	1.0 ~ 2.2

Flow rate and power consumption are able to be different with the presense of chemical, opening size of screen, Filters. This flow rate is based on screen opening 0.1mm.

## Pipe Mixer and Flocculator(PMF)

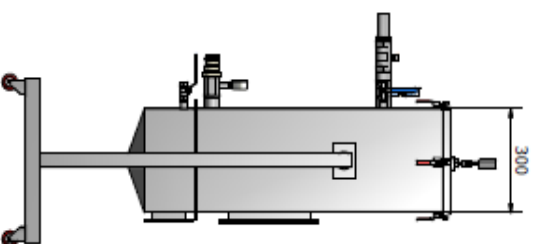
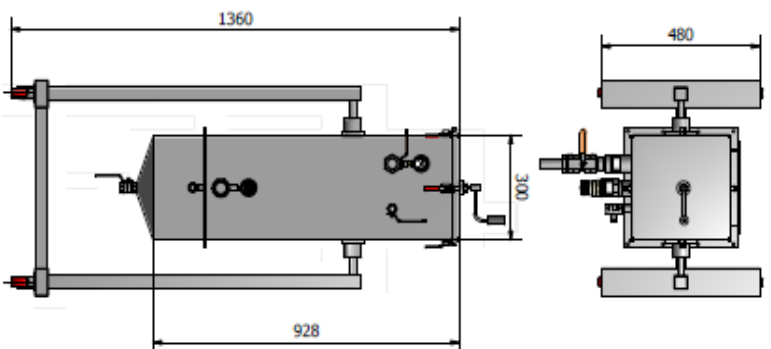


Created by SINNO	Checked by	Approved by	Date	Date	
			2012.06.16		
PMF-250			NCSST Co., Ltd		
Assembly's			Drawn	Sheet	
			1 / 1		



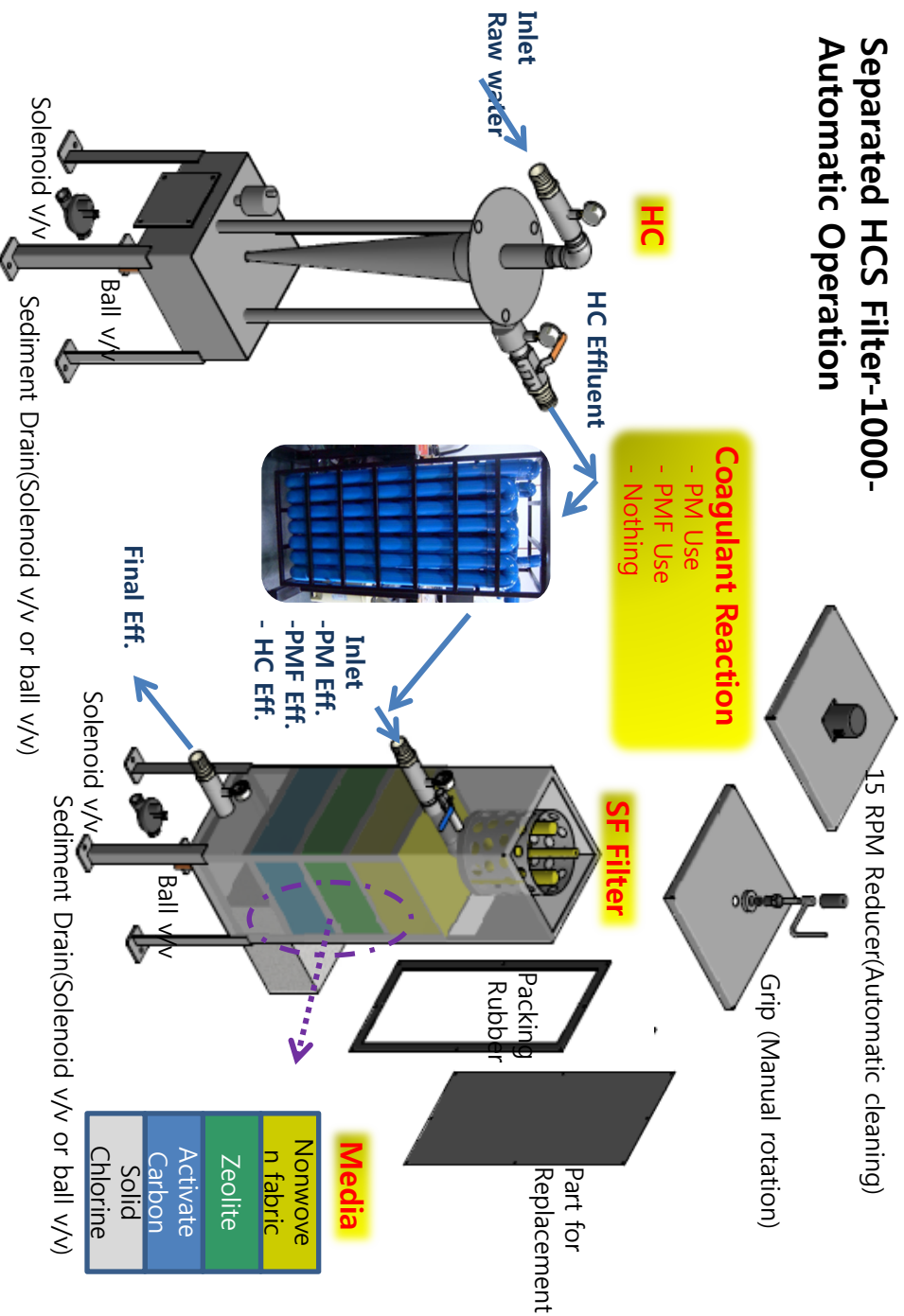
General and Perspective Drawing  
on Hydro cyclonic, Screening , Filter (HCS Filter – 500)

# 연속 고액분리 여과장치

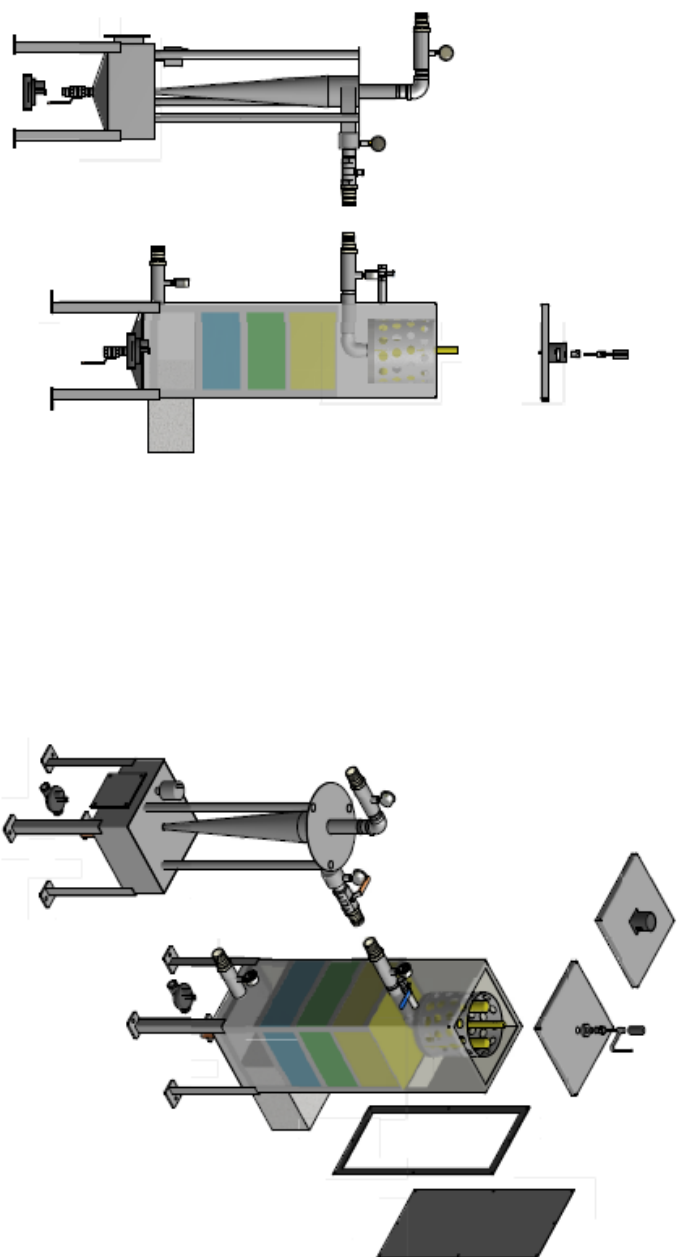


Company Kong	Contract	Agreement	Date	Date	
NGST Co., Ltd.			HCS Filter - 500		
Assembly20-1			Order	Sheet	
				1 / 1	

# Separated HCS Filter-1000- Automatic Operation



# Separated HCS Filter-1000-Automatic Operation



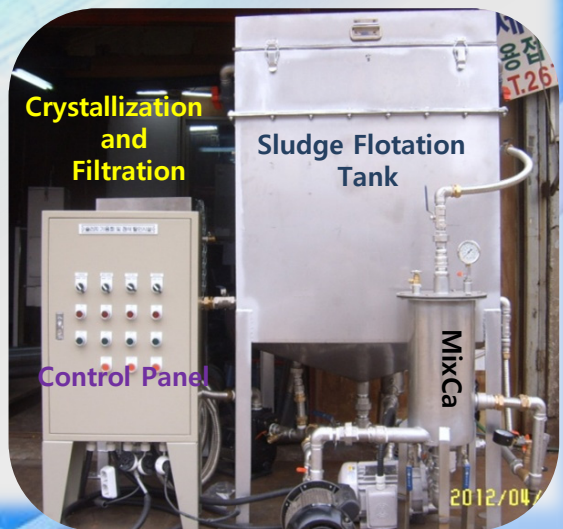
Designed by HP	Checked by	Approved by	Date	Drawn 2012-06-07	
Assembly/71-a				Edition 1 / 1	Sheet 1 / 1



### 3. Sludge Solubilization and its Application

- Solubilization, Crystallization of Sludge
- Sludge Recovery as Fertilizer and Carbon Source
- Increased methane after Sludge Solubilization

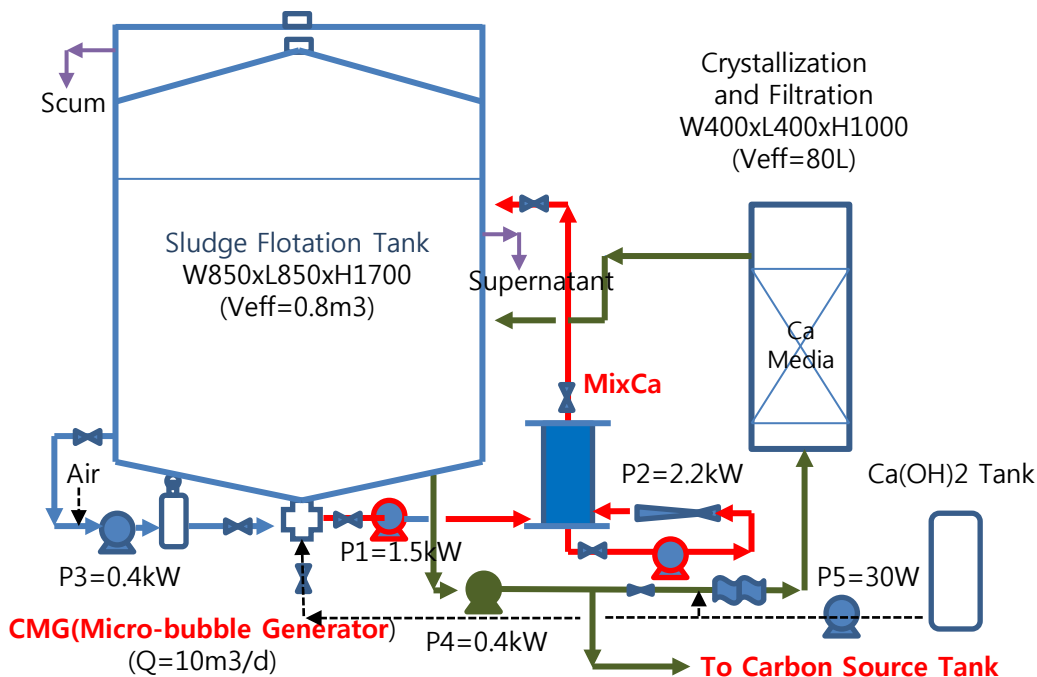
MixCa™(Sludge Solubilization Process) easily dispersed, destructed, and solubilized the organic solids such as sewage sludge, food waste, stock waste. It can be attached as a pre-treatment unit in anaerobic process to generate a useful bio-gases like methane and also offered as a solubilized carbon source for a simple biological nutrients removal process without internal recycling. The figure below is the equipment for solubilization of sludge, separation of TN and TP from sludge, crystallization of TN or TP as struvites, carbon source supply without TN and TP.



MixCa™ with Separation, Crystallization and Filtration Process  
Capacity :0.5 ~ 3.0 m3/day of thickened excess sludge  
Size :W1700xL1500xH1700



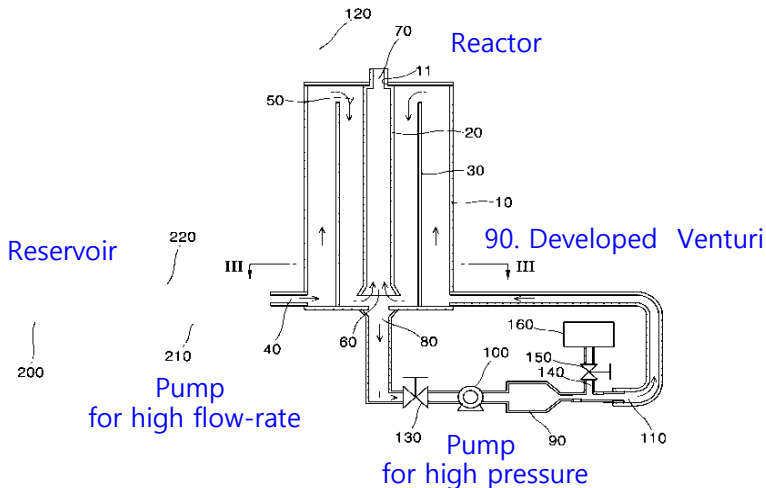
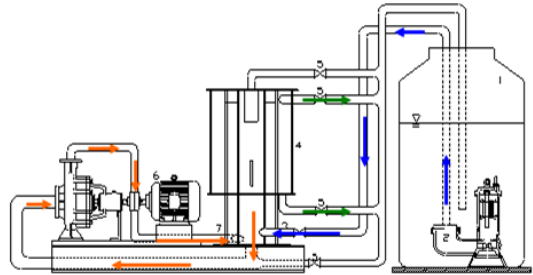
## MixCa™ with Separation, Crystallization and Filtration Process



Pump	Contents	Power(kW)	Run Time(hr)
P1	Sludge Feeder	1.5	22
P2	For cavitation(15atm)	2.2	22
p3	Make micro-bubble water	0.4	2.0
P4	Supply to Crystallization and carbon source tank	0.4	1.0



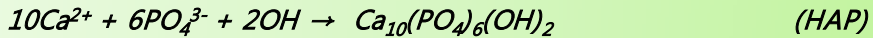
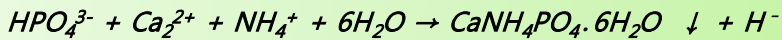
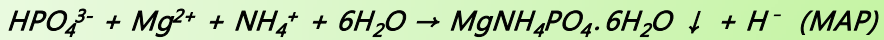
## Principle of MixCa™



Organic waste solids and sledges, which are input by the pump in the direction of the external cylinder contact, make vortex at high speed and move up along the space in the cylinder. At this time, strong shear happens because of the frictional force among fluids or with the internal cylinder and the difference of shear speed. As a result, solids or microorganisms of sludge influenced by collision, impact, and shear force while moving become corpuscular or solubilization by destruction of membranes. And when they pass through the internal cylinder, cavitations is made; and when cavitations bubbles collapse solids and sludge dissolved, oxidized, and crushed by the local formation of high temperature (about 5,000 °C), high pressure (several Gpa) and radical; then the properties of solids are changed. With cavitations device of an orifice type installed at the back, Powermax can expedite to solubilize sludge using its simple structure and multi-functions.

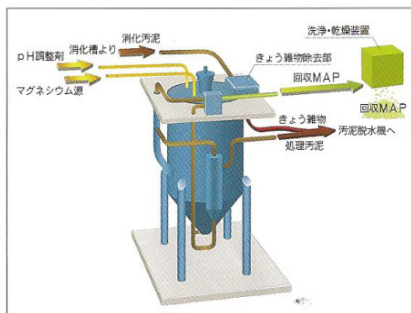
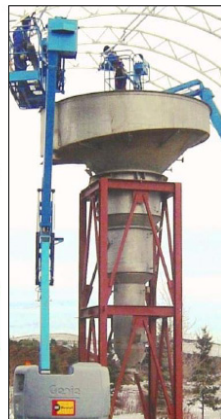
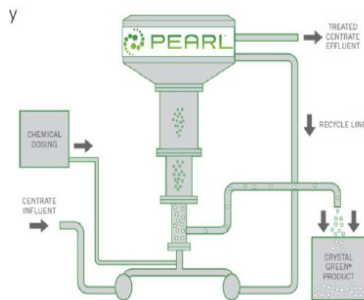


## Crystallization of N and P as MAP and HAP

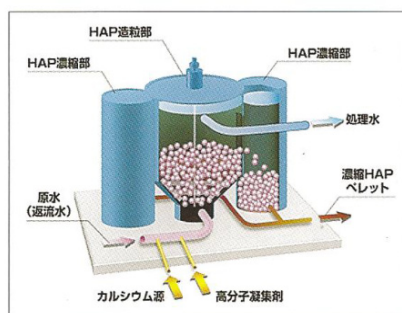


MAP ; Magnesium Ammonium Phosphate, HAP; Hydroxylapatite

Commercialization of technology  
for recovery as MAP and HAP from wastewater plant



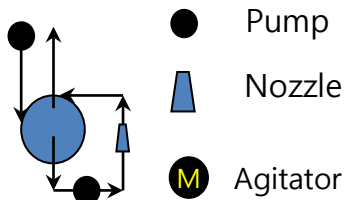
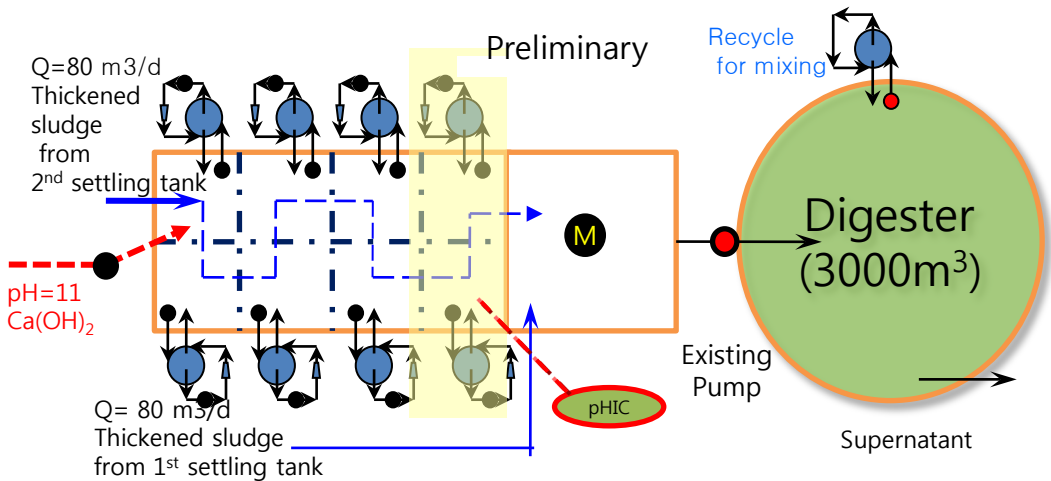
汚泥MAP型



返流水HAP型



## Proposal for MixCa 160m<sup>3</sup>/d and Digester 3,000m<sup>3</sup>

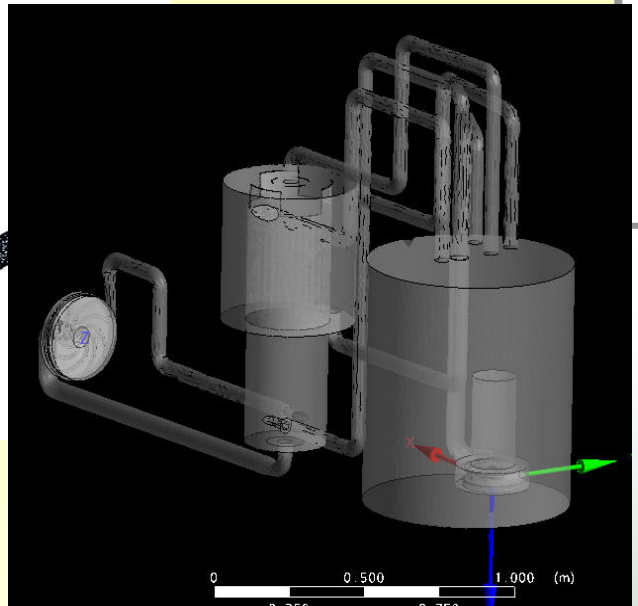
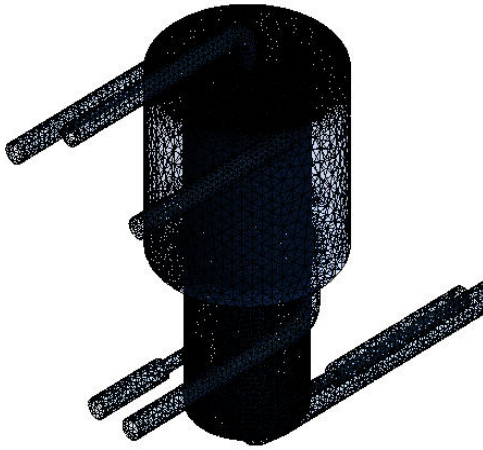


D800 x H 1200(22.0kW)

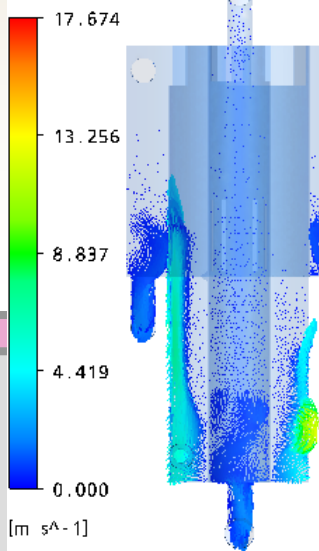
- MixCa 6 set (2 set Preliminary + Mixca 1 set for recycle :
- Total Power Consumption : 140 ~ 180 kW
- Size of Reaction Basin with MixCa : W 3000 x L 6000 x H 1500(Heff 1000)



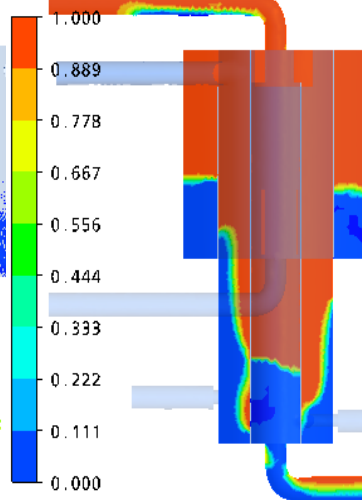
# CFD(Computational Fluid Dynamics)



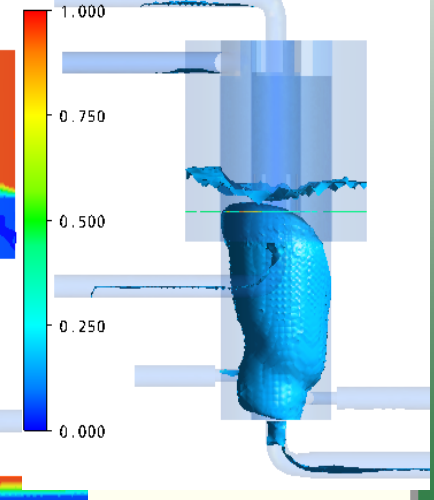
Water Superficial Velocity  
(Vector 1)



Water Vapour at 25 C. Volume  
(Contour 6)



Water Vapour at 25 C. Volume Fraction  
(Isosurface 1)

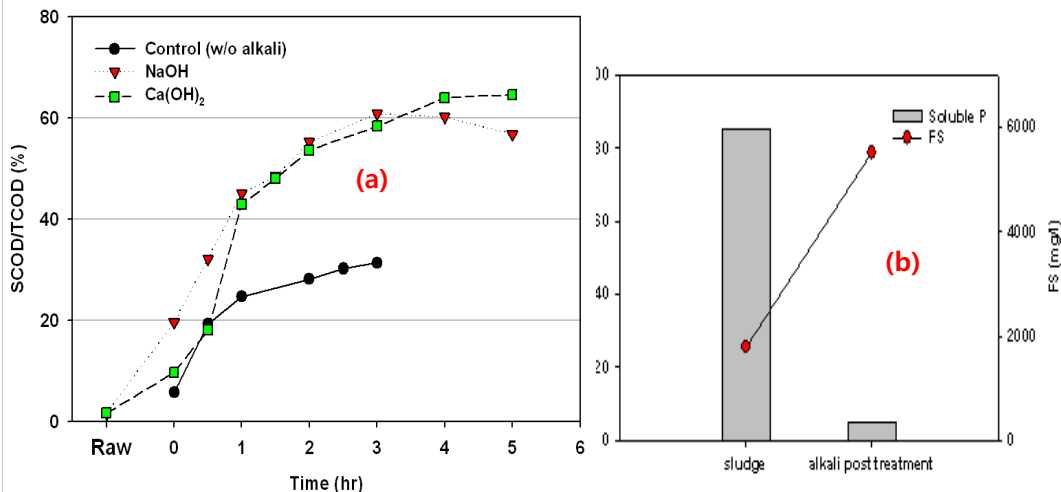


**Cavitation and RSM Model**



## ✓ Experimental Results with MixCa and its application

Thickened Excess Sludge 3 m<sup>3</sup>/day, TCOD=13,000 mg/l MixCa D400xH1000, 13kW



(a) Achievement of a great 60% of solubilization

(b) Soluble Phosphorus reduction from 85 mg/l to 5 mg/l and generation of HAP

(c) VFA increased from 0 mg/l to 3,230 mg/l, which is 25% of TCOD.

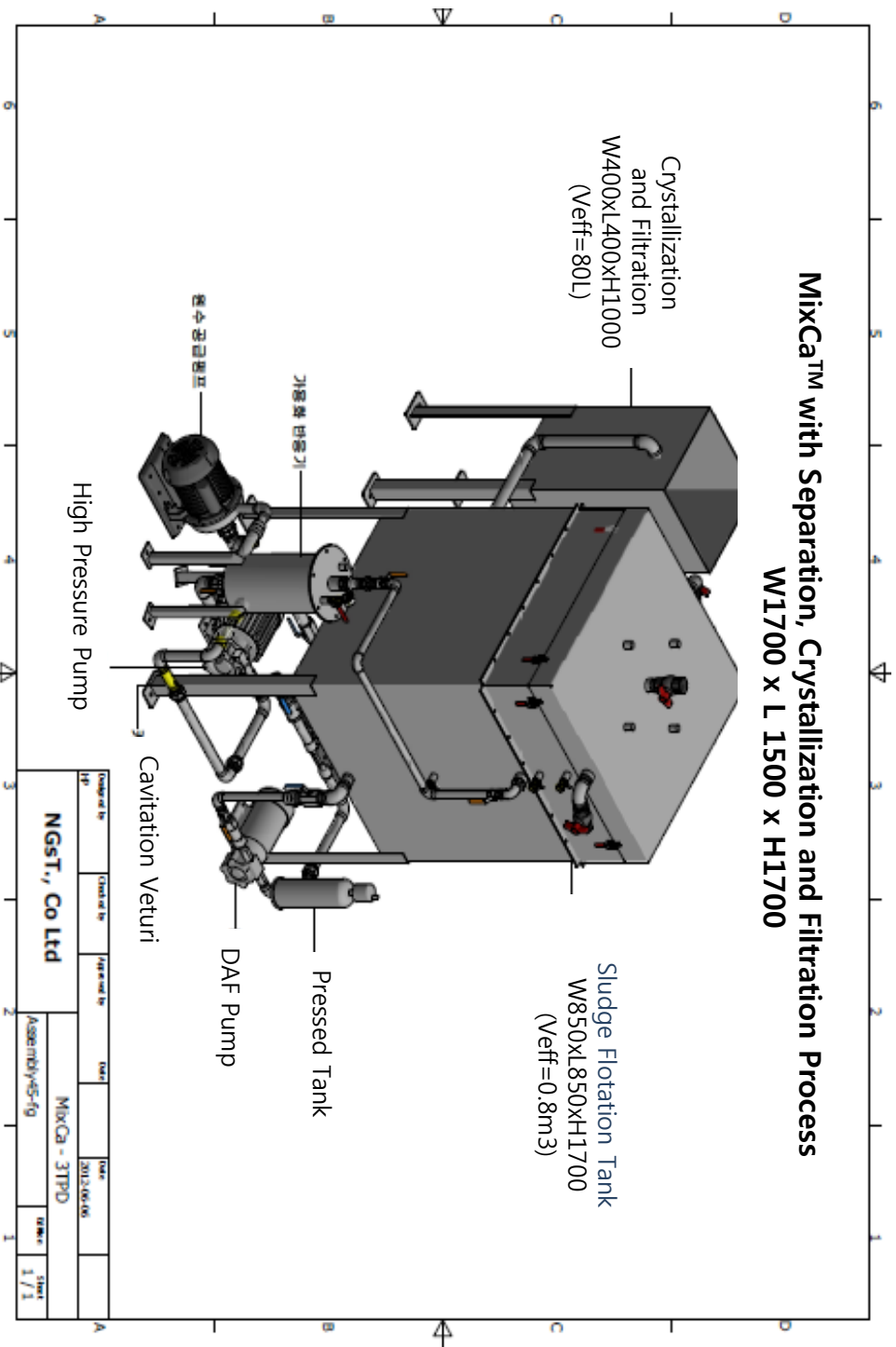
(d) Production of methane increased 50% more than conventional digester

## ■ Specifications of MixCa

Flow rate (m <sup>3</sup> /d) <sup>1)</sup>	Size(m) <sup>1)</sup>	Power Consumption (kW) <sup>1)</sup>
0.3 ~ 0.5	Φ0.20 x H0.8	2.5
0.8 ~ 1.5	Φ0.35 x H0.8	6.0
2.0 ~ 3.0	Φ0.40 x H1.0	10
4.0 ~ 7.5	Φ0.50 x H1.0	18
More than 10	More than Φ0.70 x H1.2	More than 25

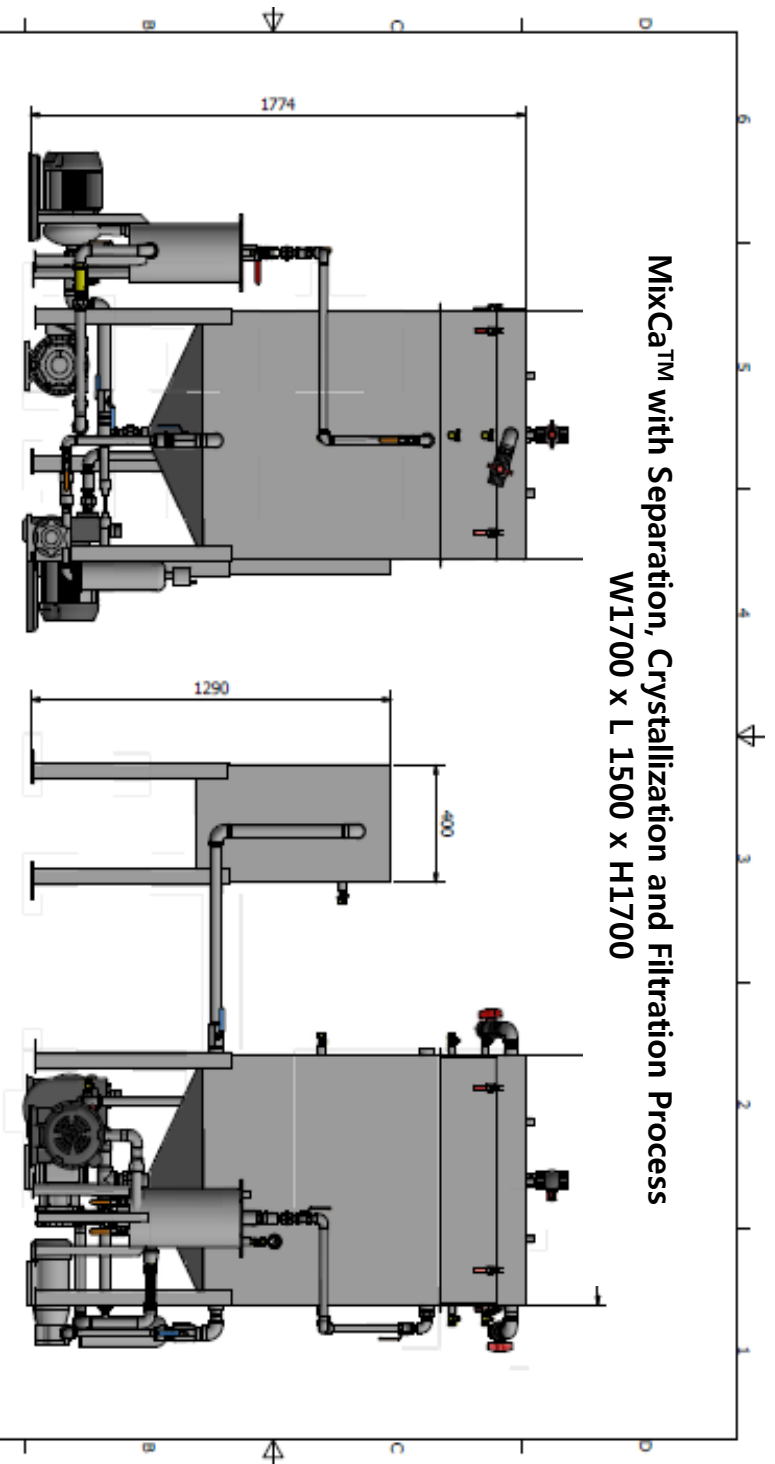
1) Based on thickened excess sludge

# MixCa™ with Separation, Crystallization and Filtration Process W1700 x L 1500 x H1700



Designed by	Checked by	Approved by	Total	Total	100%	1 / 1
NGST, Co Ltd			MixCa - 3TPD		100%	1 / 1
			Assembly-5S-7g		100%	1 / 1

# MixCa™ with Separation, Crystallization and Filtration Process W1700 x L 1500 x H1700



Designed by	Checked by	Approved by	Date	Date	
1P				2012-06-05	
NGST Co., Ltd			MixCa - 3TPD		
Assembly: 45-C			Drawn	Issue	
			1	1 / 1	

# 4. Non-Point Source Control

Non-point source pollutions including combined sewer overflows (CSOs) and storm water runoff discharges a great deal of pollutants into the receiving water without any treatment during an early period of rainfall.

CSOs and storm water runoff contain various priority pollutants and harmful substances such as oils, PAHs, PCBs and toxic heavy metals including lead(Myers et al.,1985). Urban non-point source released 760 times more load of lead than point source such as typical sewage

Type of Wastewater	BOD <sub>5</sub> (mg/l)	SS (mg/l)	TN (mg/l)	TP (mg/l)	Lead (mg/l)	Total Coliforms <sup>1</sup>
<b>CSOs</b>	<b>60-200</b>	<b>100-1100</b>	<b>3-24</b>	<b>1-11</b>	<b>(0.4)</b>	<b>10<sup>5</sup>-10<sup>7</sup></b>
Urban stormwater runoff(typical) <sup>2</sup>	10-250 (30)	3-11,000 (650)	3-10	0.2-1.7 (0.6)	0.2-1.7 (0.6)	10 <sup>5</sup> -10 <sup>8</sup>
Typical sewage	160	235	35	10	NA <sup>3</sup>	10 <sup>7</sup> -10 <sup>9</sup>
Roof runoff	3-8	12-216	0.5-4	NA	0.005-0.03	10 <sup>2</sup>

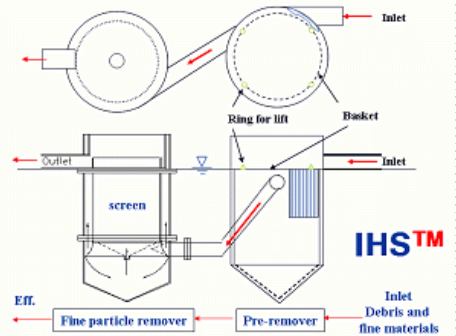
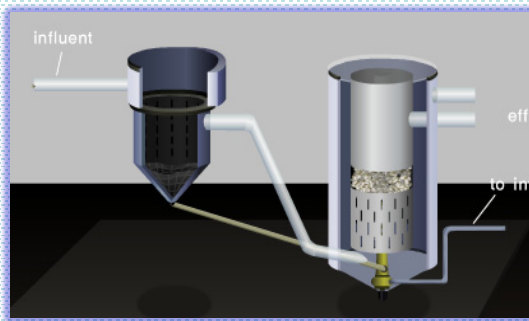
Note: 1. unit= MPN/100ml, 2. ( ) = mean, 3. NA = not available



# I H S (Innovative Hydrodynamic Separator)

## Introduction

Innovative Hydrodynamic Separator (IHS) enables to treat every kind of solid efficiently within a short time. In a reactor, centrifugal separation, screening, static precipitation and filtration can be performed. It is installable for non-point source control, pretreatment of wastewater, rainwater utilization, and pretreatment for rainwater storage basin and rainwater pumping center.



## Principles

**Pretreatment Basin :**Through the centrifugal revolution of fluids and the difference of specific gravity of materials, it simply separates gross solids including sediments, draws a removable basket, and then removes deposited solids.

### **Treatment Basin :**

The fluid that flows in through the bottom external tube:

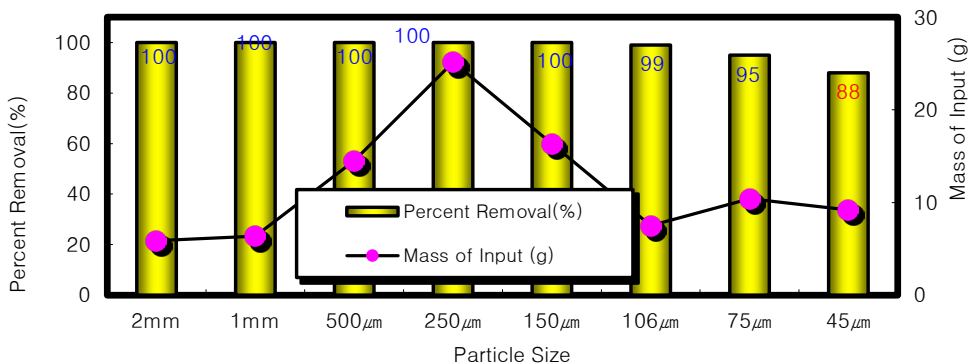
- 1) Centrifugal-revolves mathematically by a guiding plate and gets removed by friction and cyclone;
- 2) The velocity of the running fluid slows down rapidly while it passes in the direction of screen contact;
- 3) In the screen, static precipitation is possible and gravity precipitation made;
- 4) Some micro particles that are not removed out pass through the removable carrier, having small head loss while the fluid goes up. The efficiency of removal becomes improved by filtration.

Planned Flux $\text{m}^3/\text{d}(\text{m}^3/\text{sec})$	Max. Capacity $(\text{m}^3/\text{sec})$	Inlet pipe size (cm)	Pre-treatment Basin (m)		IHS		Total Area( $\text{m}^2$ ) (W $\text{m}^* \text{L}$ m)	Capture Area (ha)
			Diameter	Height	Diameter	Height		
500(0.006)	0.012	15	0.9	1.12	0.9	1.2	1.4 * 2.3	10~20
1200(0.014)	0.028	20	1.2	1.50	1.2	1.50	1.7 * 2.9	24~48
2500(0.029)	0.058	25	1.5	1.88	1.5	1.88	2.0 * 3.5	50~100
4000(1.146)	0.092	30	1.8	2.26	1.8	2.26	2.3 * 4.1	80~200
10000(0.116)	0.232	40	2.1	2.64	2.45	3.00	3.0 * 5.1	200~400
20000(0.231)	0.462	50	2.1	2.64	3.06	3.50	3.6 * 5.7	400~800
30000(0.347)	0.694	60	2.1	2.64	3.45	4.00	4.0 * 6.1	600~1200

In case of using an improved rain gutter for pretreatment, the total area is reduced to less than half or omitted.

The pretreatment basin can remove solids with less than 1mm-sized particles and its specifications and quantity vary according to the load of gloss solids.

## Results of Particle Separation Test on Pavement



The result of the test using the samples of road surfaces: 98% removal for 1.0~1.5 minutes (HRT); the particles of 106µm size were 100% removed while the particles of 45µm were removed by 88%. Based on EMC (Event Mean Concentration): 90% removal expected for SS and 70% removal for BOD. In case of installing a removable carrier, removal of heavy metals, micro-particles and organic matters was highly improved.

※ Based on overseas design: 90% removal for 2.65 specific gravity and 150µm-sized particles (80% for SS and 60% for BOD)

**Efficiency of removing cilia :** The result of the test of injecting 5g by the length of hair (2,5,10 and 20cm)

Length	20cm	10cm	5cm	2cm
Removal Rate	100%	100%	100%	99.8%



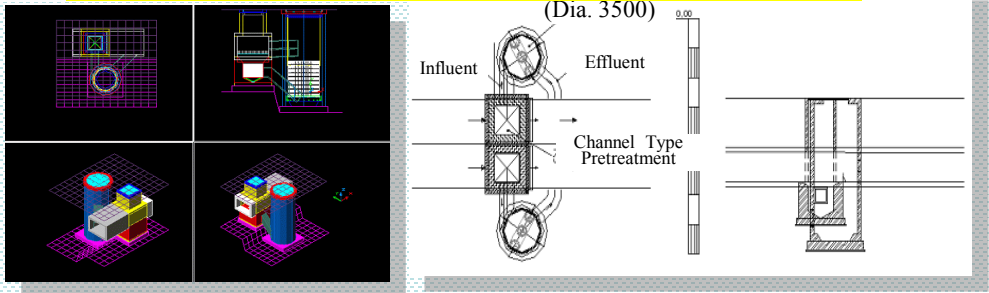


## Test for applicability of a removable media to the inside the screen

**Purpose of the test** :Removable media to remove pollutants in the screen, Sponge (including activated carbon coating), Granular activated carbon, Zeolite, Ring type, Ciliary, Bactericidal media.

**Pollutants** :Heavy metals, Organic matters, Micro particles of  $25\mu\text{m}$  and less, Pathogenic microorganism

Design for 100,000 ton/day IHS System, Location : Paju, Korea



**Table. Performance comparison for hydrodynamic separators**

(Source: Sacramento Stormwater Management Program,1999 except for IHS)

Product	Performance Data (% removal/capturable size)		Note of Performance Data
	TSS(%)	Particle size( $\mu\text{m}$ ) <sup>1)</sup>	
Vortechs	80 <sup>2)</sup> , 84 <sup>3)</sup>	NA	2) Lab test at 24 gpm/ft <sup>2</sup> 3) 7storm events. EMC <sup>c</sup> base
Downstream Defender	NA	150 $\mu\text{m}$ for 90% removal	NA
CDS	84 <sup>4)</sup> , 70 <sup>5)</sup>	425 $\mu\text{m}$ for near 100%	4) Lab test at 125 gpm 5) 4700 $\mu\text{m}$ aperture not effective for TSS<75mg/l
Stormceptor	80 <sup>6)</sup> , 26 <sup>7)</sup> , 93 <sup>8)</sup> , 53 <sup>9)</sup>	NA	6) 4 storm events. EMC base 7) 45storm events. EMC base 8) 3 storm events. EMC base 9) 4 storm events. EMC base
IHS	85-95	106 $\mu\text{m}$ <sup>10)</sup> for near 100%	Detention time 1.5 min 2 storm events. EMC base

## 5. Combination of technologies



### Purification Technologies of River, Lake and Pond



### Corrosive waste water treatment

Polluted river, lake and pond are able to be purified and prevented by using PMF, CMG&NPF HCS Filter , IHS and other technologies as like bellows

- ✓ Pipe Mixing and Flocculating : PMF™
- ✓ Compact Hydro Cyclone-Screening-Filtering Filter: HCS Filter™
- ✓ Micro bubble Generator and Flotation Tank : CMG™ & NPF™
- ✓ Surface Aerator with removal of scum : Centrox™ Aerator
- ✓ Use of EM(Effective Microorganisms) impregnated to clay ball
- ✓ Prevention of first Flush or non-point pollution : IHS™

When dealing with the following corrosive waste water, materials of product should be considered seriously

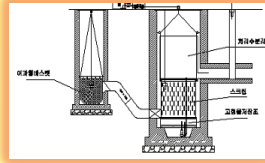
- ✓ Sea water for reuse using R/O and U/F
- ✓ Ballast water
- ✓ Acid and alkali wastewater

NGsT company can provide the corrosive wastewater treatment process such as CMG™ , NPF™ , PMF™, HCS Filter™ using non-corrosive materials, PVC and PP.

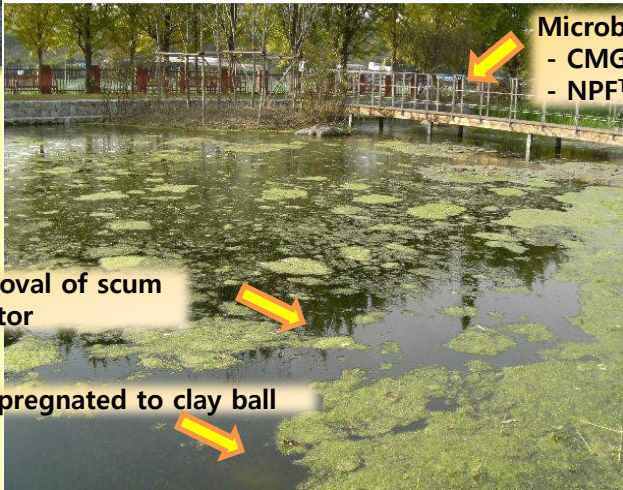


# River, Lake, Pond Purification Technology

## Prevention of NPS(IHS™)



## Microbubble - CMG™ - NPFT™



## Aeration and removal of scum - Centrox™ Aerator



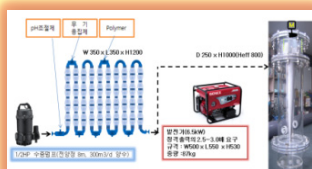
## Use of EM impregnated to clay ball



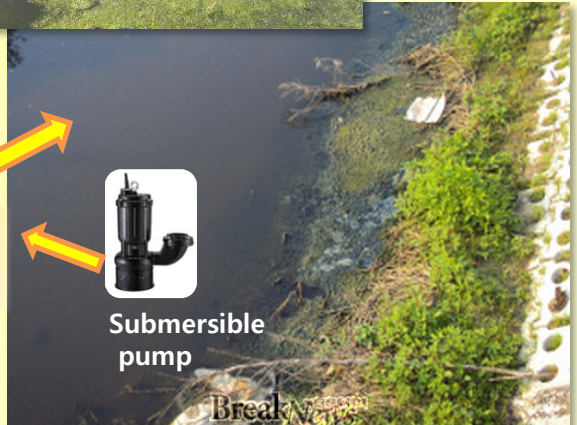
Cleaned water

## Off side Treatment and Injection of a cleaned water

: PM™, PMF™ / NPFT™ / HCS Filter™

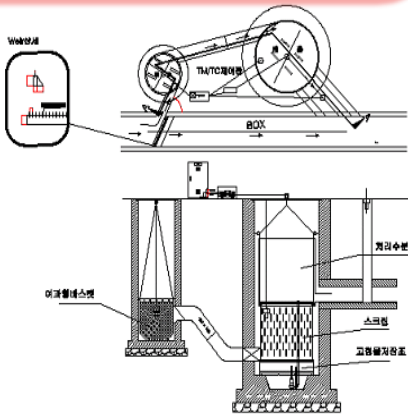


Submersible pump





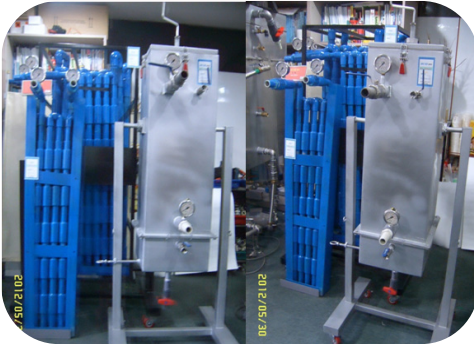
## IHSTM : Control of Non-point source pollution



## CMG™ & NPF™ Using Micro bubble Generator



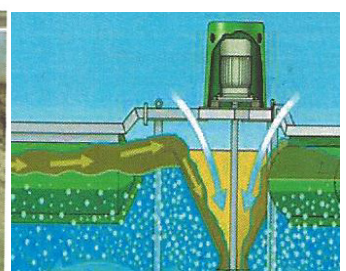
## PMF™ & HCS Filter™ Chemical and Filtration treatment



## Use of EM impregnated to clay ball



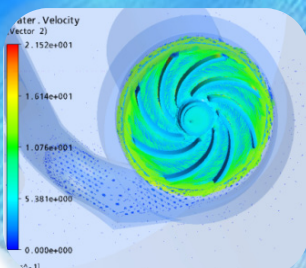
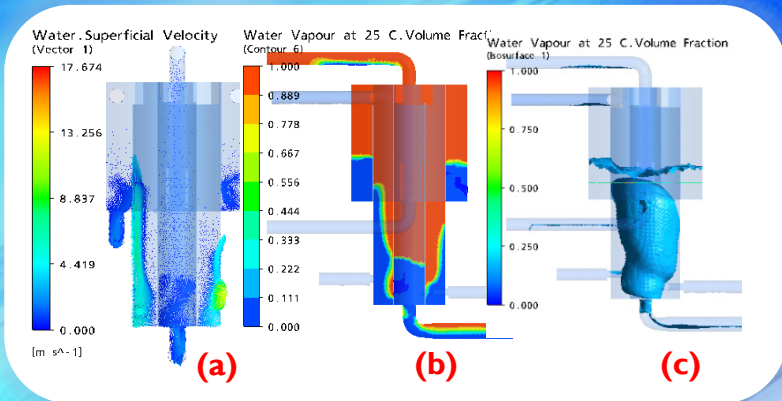
## Centrox™ Aerator : Surface Aerator with removal of scum



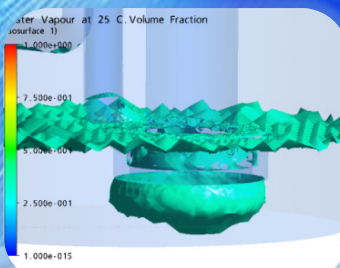
## 6. Design and manufacture using CFD and 3D analysis

NGsT company has performed the design and manufacture of the environmental equipment and unit using analysis of 3-D CAD and computational fluid dynamics(CFD)

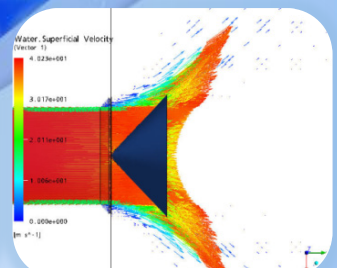
Study on the MixCa device for sludge solubilization using CFD has been carried out and the results are shown in the figure below. The main models used in the CFD are RSM(Reynolds Stress Model) and Cavitation Index. (a) Each part of the reactor, MixCa, is shown as a vector of the fluid flow rate, (b) the fluid and vapor from the reactor will show the concentration distribution, (c) The surface of the fluid in each cylinder within the reactor is shown. In this case, because you can not see the inner part of the reactor, CFD analysis is very useful. In addition to NGsT have experience in the design for turbine, agitator and pump, cavitation analysis on different kinds of valves, odor flow analysis, energy diagnosis using CFD



Plan view of Submersible pump



Side view of Submersible pump

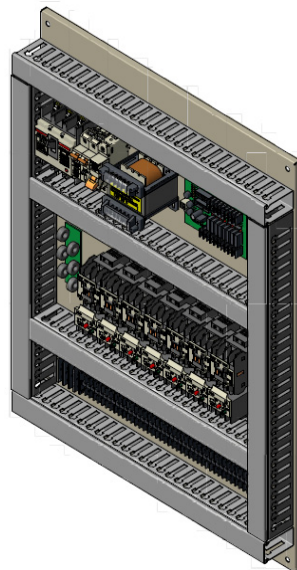


Cavitation analysis on valve

When you obtain 3D design about device your want make ;

- # Design and Fabrication through 3D

## PLC and Control box

[illegible]



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