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PROPOSAL
ON
CASUTIC SODA PLANT
2,000 MT per Year(100%)

Shanghai Metex Business Consulting Co.,Ltd
Shanghai
China

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Summary

1. Outline of technical proposal..... 2
2. Scope of supply..... 2
3. Exclusions.....3
4. Battery limits.....3
5. Site conditions.....3
6. Raw material quality and consumption index..... 4
7. Product categories and Production scale 6
8. Standards.....7
9. Process flow drawing.....9
10. Process description.....10
11. Workers..... 17
12. Workshop Area..... 18

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1. OUTLINE OF TECHNICAL PROPOSAL

This plant is to produce caustic soda and chlorine by salt and water through electrolyzing in electrolyzer. Our plant is composed of following parts:

- Primary Brine
- Secondary Brine
- Electrolysis Process
- Dechlorine process
- Wasted Chlorine Treatment（chloros）
- Hydrochloric Acid
- Instruments and DCS system
- Rectification Transformer（20KV Inlet Voltage）、Dynamic Power Distribution

The plant is based on the most experimented technology which ensures easy operation and low energy consumption. The plant requires a minimum of operators for control and supervision of various sections.

2. SCOPE OF SUPPLY

Asia Chemical Scope of Supply includes:

- Know how
- Base engineering
- Detail engineering
- Equipment and machinery(see equipments list)
- All electric motors
- Automatic control valve
- instrumentation includes:

  DCS Centralized Control System

  Field instrumentation

  Panel instrumentation

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3. EXCLUSIONS

- Tank area
- the tank whose vapacity is more than 70m³（-3 units）
- Building steel structure
- Pipe and manual valve
- All under ground piping
- Electric system includes:
  control panel
  electrical and instrument cables with erection accessories
- analysis instrument
- Lighting system
- Lightning system
- ELighting system
- Earthing system
- Erection of equipment and machinery
- Prefabrication and erection of piping steel structure
- Installation of instrumentation and electrical cables
- Final painting
- Packaging system
- All that is indicated with word “Client” in the supplier column of equipment list
- Services platform
- Service steel structures
- Auxiliary Equipments（f.g Compressed air、Pure water、Chilly water、 Nitrogen、Circulating water system）
- Everything else not clearly mentioned in the offer

4. BATTERY LIMITS

The plant battery limits are defined at 1 m. outside the building where the plant will be installed or 1 m. outside the occupied area for the unite/equipment installed outdoor.
For what concerns the electric power supply, the battery limit is defined at the feeding point of electric power distribution panel.

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5. SITE CONDITIONS

Site data are indicated here below. Client will confirm/amend the data before final contract negotiation.

The design and the section of the plant equipment/materials will be made according to the following site conditions:

Dry bulb temperature design: need meteorological condition
Relative humidity design: need meteorological condition
Design air temperature: need meteorological condition
Design wind speed: need meteorological condition

Geographic/geophysics data:

-Height above Mean Sea Level: need geology condition

-Earthquake classification: need geology condition

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6. RAW MATERIAL QUALITY AND CONSUMPTION INDEX

1. 32% Caustic Soda Consumption Quota (calculated as 1 ton of 100% NaOH).

No.	Name and Spec	Unit	Qty.	Remark
1	Salt（NaCl 100%）	ton	1.584	
2	Sodium Carbonate （Na2CO3≥98%）	ton	0.0082	
3	High-pure Hydrochloric Acid （100%HCl）	ton	0.0465	
4	Sodium Sulfite Na2SO3≥95%	ton	0.0015	
5	Barium Chloride （BaCl2.2H2O≥98%）	ton	0.027	
6	Demineral water (EC≤5us)	m^3	1.5	
7	Ion Exchange Resin	L	≤0.0091	
8	Caustic Soda (NaOH 100%)	ton	0.0081	
9	Steam 0.3MPa G	t	0.5	
10	Circulating Water △t=8℃	m^3	84	
12	Water for production 25℃	m^3	2.5	
13	Dynamic Power 380V	kWh	180	
14	DC Direct Current Consumption	kWh	2200	
15	Ion Membrane	m^2	0.006	
16	Instrument Air 0.6MpaG	Nm^3/h	150	
17	Process Air 0.6MpaG	Nm^3/h	200	discontinuous
18	Nitrogen 0.6MpaG	Nm^3/h	300	discontinuous

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3.High-pure HCL Consumption Quota（calculated as 31.5% hydrochloric acid for each ton）

No.	Name and Spec.	Unit	Amount	Remark
1	Chlorine Cl_2=100%	ton	0.302	
2	Hydrogen Gas H2=100%	ton	0.0093	
3	Circulating Water	m^3	40	△t=8℃
4	Demineral water (EC≤5us)	m^3	0.8	
5	Instrument Air 0.6MpaG	Nm^3/h	30	
6	Dynamic Power 380V	kWh	5	

4.12.5% chloros (calculated as 1 ton of 13% chloros)

No.	Name and Spec.	Unit	Qty.	Remark
1	Industry water	m^3	0.45	
2	Dynamic Power 380V	kWh	15~20	
3	Chilly Water 7℃	m^3	10	△t=5℃

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7. PRODUCT CATEGORIES AND PRODUCTION SCALE

1) caustic soda
Production Capacity:
≥32%NaOH 6250T/Year
Product Specification:
NaOH 31.5-32.5%
NaCl ≤40wtppm
NaCLO3 ≤10wtppm
Fe2O3 ≤3wtppm
2) Hydrochloric Acid
Production Capacity:
31.5%HCL 5500T/Year
Product Specification:
General Acidity (HCl) ≥31.5
Iron ≤0.01
Arsenic ≤0.0001
Burning Residual Amount ≤0.15
Oxide (Cl) ≤0.01
3) chloros
Production Capacity:
Chloros 3300T/Year
Product Specification:
AV CL % ≥15

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8. STANDARDS

Our company will comply with the following standards (The series standards are made and published in China by referring to international ISO standards).

GBJ16-1987 <Building Design Fire Protection Code>
GB50058-1992 <Design Criteria of Power Plant in Explosion and Fire>
HG/T20675-1992 <Design Criteria of Earthing for Chemical Enterprise>
GBZ1-2002 <Design Sanitary Standard for Chemical Enterprise>
GB 18071-2000 <Chlor-alkali Factory(produce alkali by electrolysis) Sanitary Protection Distance Standard>
HG20570 <Process System Project Designing Technical stipulation>
HG20546 <Chemical Plant Pipeline Layout Designing Stipulation>
HG/T20649 <General Drawing Transportation Design Criteria for Chemical Enterprise >
JB/T4735-1997 <Steel Welding Normal Pressure Vessel >
GB150-1998 < Steel Pressure Vessel>
GB151-1999 < Shell and Tube Heat Exchanger >
JB/4731-2005 < Steel Horizontal Vessel >
JB/4710-2005 < Steel Tower Vessel >Steel Tower Vessel >
GB/T8163-1999 < Fluid Conveying Seamless Steel Pipe >
GB/T3092-1993 < Welding Steel Pipe for Low-pressure Fluid Conveying >
GB985-88 < Basic Types and Dimensions of Weld Grooves of Oxyacetylene Weld, Manual Electrical Arc Weld and Gas Shielded Arc Welding >
HG20583-1998 < Steel Chemical Vessel Structural Designing Stipulations>

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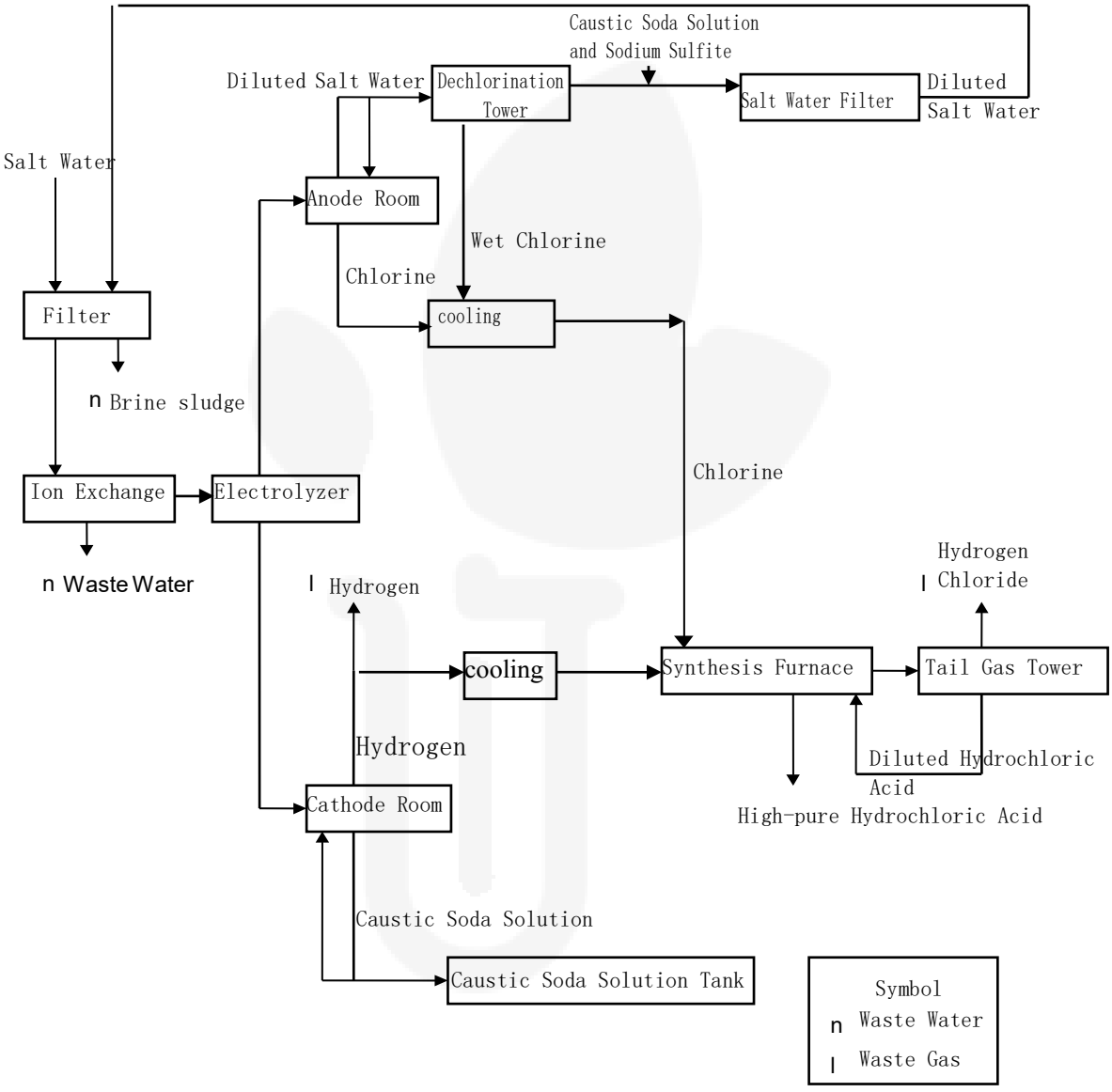

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9. PROCESS FLOW DRAWING

10. PROCESS DESCRIPTION

After mixing uniformly in the water distribution trough, the dilute brine from dechlorion, reclaimed wasted salt water, cleaning water from the treatment of salt slurry (plate frame filter press) and other salt waters, are conveyed with pressure by feeding pump, after heated by steam up to 50°C in steam-water mixer, enter into salt melting trough to melt the solid salt, until get the saturated brine which could meet concentration requirement(~310g/L).

The crude brine from the salt melting trough flow into the reaction trough R010a/b,added the Na2CO3,NaOH,and BaCl2 separately (or set individually the SO4 removal system for BaSO4 recovery) and make refinery reaction to remove Ca,Mg,SO4 ion in the crude salt water.

By flowing out of reaction trough, the big mechanical impurities of the Brine are removed in strainer filter, confluence in intermediate trough. Then transfer the crude salt water to ceramic membrane filtering system by primary filtering feeding pump.

The crude Brine entering filtering system is pressurized again by primary filtering circulating pump, then enter into primary filter. The cleaning liquid after filtering is the filtered brine r(SS≤1ppm),and flow into the filtered Brine tank confluence. When the solid matter of condensed salt water could meet the requirements, according to a certain proportion, part of them flow into the mud pool. The rest condensed water is still pressurized by primary filtering pump to recycle and filter again.

The condensed salt water with higher solid percentage flowing into salty mud pool pressurized to transfer to plate filter, where separate the salt water from the slurry, and the salt water and cleaning water after filtering flow into the filtering trough to confluence, then transfer with pressure to water distribution trough, melting the salt again.

2) Secondary Brine

This process is to refine the primary Brine further to meet the ionic membrane requirements.

For the annual capacity of caustic soda plant is 2KTPY,the filtered Brine with 305±5g/l NaCl at 50°C,flow into the filtered salt water trough at 2.4m3/h,then is conveyed to Brine heater up to 60°C,and then conveyed to ion exchange resin tower.

By ion exchange, make the Ca, Mg and other multivalent ion content less than specified value.

The secondary refinery brine from the ion exchange resin tower enter into electrolysis process by brine head tank. There are 2 sets of ion exchange resin tower. The two sets series connection on line and normally run, 24 hours later the first tower off-line regeneration, the second tower runs alone, the regeneration tower runs again after regenerating for 10 hours, then two towers are running.

Chelating resin regeneration need 31wt% HCL, 32wt%NaOH and pure water.

During chelating resin regeneration, after mixing with pure water,31wt% HCL is conveyed to ion exchange resin tower by sequencing valve. The concentration of solution is controlled by flow measuring system.32 wt% NaOH is treated in the same way. Acid and alkali wasted liquid produced during the regeneration will be sent out of battery limits.

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3）Electrolysis Process

Flowing into the anode chamber of electrolyzer, the secondary refined brine makes the electrolysis to generate the chlorine. The reaction formula is as follows:

NaCl— e —> Na+ + 1/2 Cl2

Dilute brine with lower concentration after electrolysis. Due to the solubility of chlorine in the brine, the dilute brine contains free chorine, so the dilute brine will be sent to be dechlorinated. In the cathode chamber, water is decomposed as H2.The reaction formula is as follows:

H2O + e OH- + 1/2 H2

OH- integrates with Na+ to generate 32% of alkali solution.

32% of alkali solution from the electrolysis flow into cathode liquid trough. Part of them mix with pure water and return to cathode chamber of electrolyzer, and the other part as the product will be sent out of the battery limits. H2 and CL2 generated from anode chamber and cathode chamber is conveyed to out of battery limits for chlorine and hydrogen process.

Electrolysis process is made up of 1 sets of electrolyzer and concerned equipments, such as dilute brine trough, dilute salt brine pump, alkali tank, liquid alkali pump, cathode liquid cooler, and pipe filter etc. Electrolyzer is made up of 28 pairs of cell, 28 sheets of ion exchange membrane and its accessories. Electrolyzer cell is made up of metal anode, active cathode, anode chamber and cathode chamber. Accessory is made up of hydraulic system, feed inlet and outlet general pipe, flexible conduit of anode and cathode liquid inlet and outlet the gasket of anode and cathode, flexibleness cable connecting electrolyzer with fixed conducting copper, and protection device against electricity corrosion etc.

Refined salt water from secondary brine refinery process is conveyed to anode The flow is controlled by flow meter of each electrolyzer to keep the concentration of anode liquid up to the specified value. The flow value is made cascade control by direct current of each electrolyzer. Hydrochloric acid concentration 17% is used to neutralize OH ion passing through the ion membrane, then is continuously conveyed to anode chamber with anode liquid via flowmeter.

Refined brine electrolyze in the anode chamber to generate chlorine, and meanwhile decrease the NaCl concentration. NaCl decomposition rate between inlet and outlet of electrolyzer is about 50%.

There are two flexible hose, one for connecting inlet general pipe, and the other one for connecting outlet general pipe. After electrolysis, the mixture, chlorine and dilute brine discharge into anode liquid general pipe through hose, and separate gas from liquid in the general pipe.

Dilute brine confluence in the brine tank and then is sent to dechlorination .

Chlorine is collected in the chlorine general pipe and then is sent to head trough of dilute salt water. Consequently, the water in chlorine is separated and drip. Then chlorine is sent to out of battery limits. The chlorine pressure is controlled by pressure controllers installed on the chloride general pipe.

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The purity of chloride gas is about 99vol% (dry basis).
Part of dilute brine with chlorine is returned to refinery brine pipeline against titanium pipe corrosion.
The structure of cathode liquid chamber is similar to anode liquid chamber. There are two inflexible hoses in each cathode liquid chamber, one for connecting feed inlet general pipe, and the other one for connecting feed outlet general pipe.
The purity of chloride gas is about 99vol% (dry basis).
Part of dilute brine with chlorine is returned to refinery brine pipeline against titanium pipe corrosion.
The structure of cathode liquid chamber is similar to anode liquid chamber. There are two inflexible hoses in each cathode liquid chamber, one for connecting feed inlet general pipe, and the other one for connecting feed outlet general pipe.
The caustic soda after dilution is sent to general pipe inlet of each electrolysis trough through head tank of caustic soda, then sent to cathode liquid chamber through inflexible hose. Add the pure water at the general pipe inlet of cathode chamber to keep the caustic soda concentration in the cathode liquid at the specified value. The flow of pure water is controlled by flow meter. The set value of flow meter is controlled by direct current or cathode liquid concentration cascade. Cathode liquid cooler is installed between caustic soda pump and caustic soda head tank.
Cathode liquid cooler together with temperature controller control the cathode liquid temperature. The cathode liquid adding into electrolyzer is monitored by temperature controller.
After electrolysis, hydrogen and caustic soda is generated in the cathode chamber. The mixture of hydrogen and caustic soda discharge to general pipe of cathode liquid outlet, and is separated as gas and liquid in the general pipe.
Cathode liquid confluence in the caustic soda trough, and is conveyed by caustic pump. Part of caustic soda as the product is conveyed to intermediate tank, and the rest returns to head tank of caustic soda.
The finished product is conveyed to out of the battery limits. Caustic soda flow meter measure the flow and general amount of product. Minor cathode liquid is conveyed to density meter to measure the finish product concentration.
Hydrogen confluence in the general pipeline of hydrogen, and is conveyed to head of caustic soda tank, where the moisture in hydrogen is separated and drip. Then hydrogen is conveyed to out of battery limits. The hydrogen pressure is controlled by pressure controllers installing on the hydrogen general pipe. Controllers is made cascade control by chloride gas pressure so as to keep the pressure between hydrogen and chloride at the specified value.
The purity of hydrogen is 99.9vol% (dry basis).

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4) Dechlorination process

For the dilute brine from electrolyzer, part of them is added into hydrochloric acid to adjust PH(1-2.5), entering into chlorate decomposition trough to decompose chlorine, then return to anode liquid tank. The other part is sent to top of dechlorination tower, and is separated at the negative pressure.

The dilute brine after dechlorination flow into dechlorination salt water trough with free chlorine 50mg/l, and added into caustic soda, then is added into Na2SO3 to remove free chlorine further after adjusting PH. The chemical reaction formula is as follows:

$Na_2SO_3 + CL_2 + 2\,NaOH \quad Na_2SO_4 + 2NaCL + H_2O$

Dilute salt water is sent to primary refinery process by dechlorination brine pump. After dechlorination, the chloride gas is cooled by chlorine cooler and is separated water, then is sent to general pipe of chlorine .

5) Wasted Chlorine Treatment & chloros

Wasted chlorine which need to be absorbed, enter into the wasted chlorine treatment tower (adopt packed tower or spraying tower),contact the liquid alkali from the top completely. Chloride gas reacts with caustic soda to generate sodium hypochlorite. Residue tail gas is exhausted to air from the top of tower by air fan (require that chlorine content ≤ 1mg/M3).

Absorbing alkali liquid flow to alkali circulating tank from the tower bottom, then is sent to alkali cooler by alkali circulating pump, after removing the reaction heat, return to the tower top and make the next turn of absorption. Until the absorbing alkali can meet the hypochloric acid quality requirements(effective chloride ≥12%wt, chloride content ≤1%wt).Pump to package department for selling. Newly prepared liquid alkali(16~20%wt) is supplemented to liquid alkali circulating tank(use two sets alternately),then sent into the top tower by liquid alkali circulating pump..

6) Hydrochloric Acid

From the electrolyzer, the cold chlorine and hydrogen cross their respective flame arrestor, then enter into the synthesis furnace and react with each other, to produce hydrogen chloride (HCL) which is absorbed by diluted hydrochloric acid entered in at the top from the tail gas absorption tower, then cooled to produce hydrochloric acid. The hydrogen chloride gas that have not been absorbed, crossing tail gas absorption tower, to be absorbed by water, produce hydrochloric acid which flow into synthesis furnace. The residual gas will be extracted by water spraying pump. Finally the hydrochloric acid is sent to finished product tank for selling.

Totall react : H2+CL2 =2HCL

11. WORKERS

2 workers per shift for salt water,2 workers per shift for electrolysis, 1 worker per shift for Caustic Soda Evaporation, 1worker per shift for hydrochloric acid, and 2workers per shift for DCS. Adopt the shift system that 4 groups in 3 shift , and the operators are 32 persons in total. Another 8 workers for assay, machine repair, instrument repair and electricity and administrators are 5 persons, 45 persons in total.

12. WORKSHOP AREA

The total area for whole plant requires at least 5000㎡.

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13. AUXILIARY EQUIPMENT

1	Demineral water production plant	Set	1	8 t/h	PH 7～7.5 EC 0.3～0.5 SiO2 ≤0.02 mg/l Na+ ≤0.01
2	chilly water unit	Unit	2	40m3/h	Output temperature7℃ Δt=5℃
3	Air compressor unit	Unit	2	10Nm3/min	P=0.6MPa, Oil free, Dew point≤-20℃
4	nitrogen making machine with micro-thermal regeneration dryer	Unit	2	1.5 m3/min	P=0.8MPa,Dew point≤-45℃ Nitrogen purity≥99.6%，Oxygen content≤0.5%， Oil free，
5	Circulating water system	Set	1	400m3/h	Dirtfactor≤0.0006M2.deg-K/WPH=6.5-7.5 Organiccontent≤5PPM,Δt=8℃(If the three-in-one furnace adopts the type which produce byproduct steam, the consumption of circulating water reduces 30%)
6	GAS boiler	Set	1	2t/h	P=0.7MpaG,T=170℃

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2000ton/YEAR ION-EXCHANGE MEMBRANE CAUSTIC (Solid caustic soda)			PRICE BREAKDOWN OF THE DELIVERY			
NO	Item	Individual total (USD)	Each item price (USD)			Remarks
			Equipment fee	Installation material fee	Other fee	
1	Main process equipment,installation material fee					
a	Primary Salt Water,Secondary salt water,Electrolysis,Dechlorination	2,019,144.4	2,019,144.4			
b	Wasted Chloride Gas Treatment and Naocl	137,260.5	137,260.5			32% NaOH is 6250ton/YEAR
c	Hydrochloric Acid	366,029.3	366,029.3			15% Naocl 3300ton/YEAR
f	DCS system	246,365.6	246,365.6			Hydrochloric Acid is 5500ton/YEAR
g	Rectification Transformer	408,263.7	408,263.7			
h	Dynamic Power Distribution	211,170.7	211,170.7			
	Total	**3,388,234.2**	**3,388,234.2**			
2	Other price					
a	Engineering design	281,560.5				
b	On-site technical service	147,819.1				
	Total	**429,379.6**				
	All Total (FOB Shanghai USD)	**3,817,613.80**				

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