BTS ENGINEERING
https://prom-nasos.pro
https://bts.net.ua
https://prom-nasos.com.ua
+38 095 656-37-57,
+38 067 360-71-01,
+38 063 362-12-31,
info@prom-nasos.pro

1000kg/h Carbon Dioxide Recovery Plant Quotation Sheet

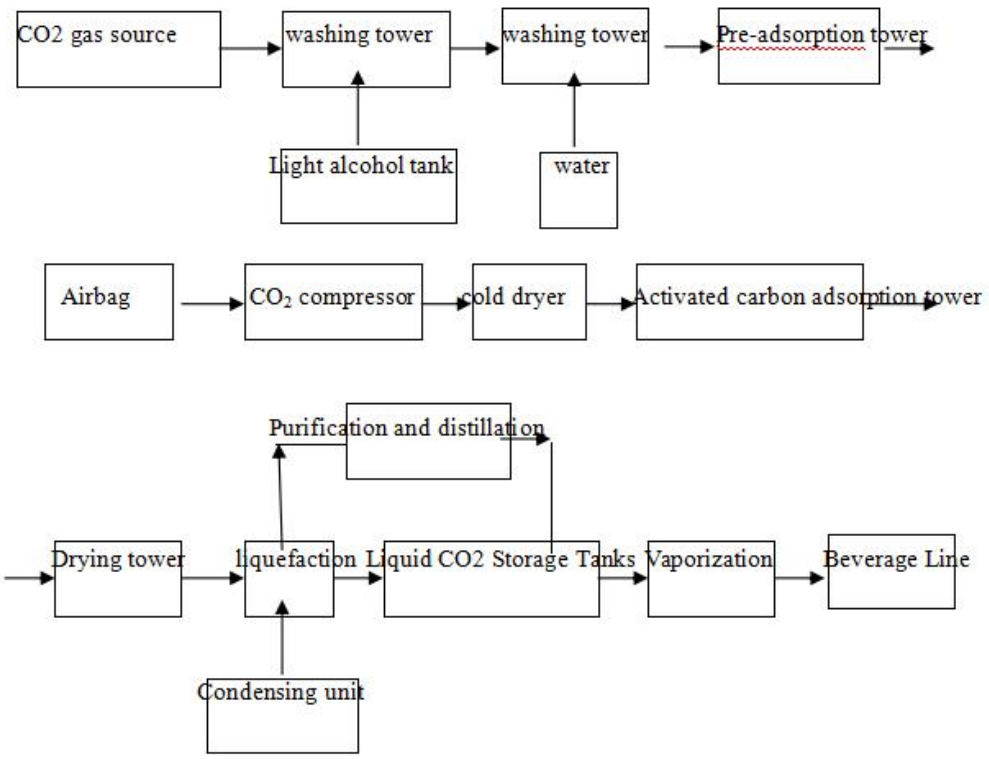
1. This design is based on

Raw gas: 96.56% CO2 from Bioethanol plant

Final CO2 impurity: food grade 99.998%

Capacity: 1000kg/h

2. CO2 recovery process flow chart



3. General specification of this system

Carbon dioxide gas recovery production capacity: 1000kg/h

Carbon dioxide recovery rate: ≥80%

Normal working pressure: 2.0MPa

Liquid carbon dioxide storage temperature: -18

Carbon dioxide purity after treatment: ≥99.998%

Voltage: 380V 50HZ

4. Introduction of our CO2 recovery system

There are three types of CO2 recovery method in the market, they are: A. Low pressure method; B. Medium pressure method; C. High pressure method

Here are the comparison of the three different methods:

	Low pressure	Medium pressure	High ressure
Recovery pressure (MPa)	0.6~0.8	1.6~2.5	6~9
Liquefaction temperature(℃)	-42~50	-12~-25	20~30
Compare (kg/m3)	18~24	994~1052	595~743
Purity (%)	Decided by Gas source	99.9~99.99	Decided by Gas source
Storage method	Unable to store	Low temperature storage	Steel cylinder storage
Gas supply	Pipeline intermittent	Pipeline intermittent	Steel cylinder supply

What we use is **medium pressure** CO2 recovery method

After the carbon dioxide is compressed and purified by a special oil-free carbon dioxide compressor, it is liquefied in the liquefaction system. The condensation temperature is -18℃~-22℃ and the density is 994~1052kg/m3. Under this working condition, the carbon dioxide liquid is easy to store in large tanks and transport by tank trucks. Liquid carbon dioxide can be directly sent to the gas point after vaporization and decompression, or it can be filled in a high-pressure steel cylinder through a booster pump. Carbon dioxide is purified by the medium pressure method, and its purity index can reach 99.998% after liquefaction and purification. Since the carbon dioxide recovered by this method has high purity, high storage efficiency and

is easy to use, most users at home and abroad choose this process method for recycling.

5. Equipment List

No.	System Name	System Composition	Specifications and Model
1	Dilute alcohol tank	Diluted alcohol tank	2M3, 304
		washing tower	Φ400 L=4000, 304
		filler	Corrugated plate 250, 316
		water pump	Lift 20M Flow 5T
		liquid level gauge	DN25 700MM, 304
		pneumatic valve	DN125 DN50
2	Water scrubber tower	Scrubber tower	Φ400 L=4000, 304
		filler	Corrugated plate 250, 316
		pneumatic valve	
3	Pre-adsorption	adsorption tower	Φ600×2000, 304
		activated carbon	CH-18 φ4 coconut shell
		pneumatic valve	DN150 DN25, 304
		electric heater	15KW, 304
4	Airbag	airbag	40M3 φ3200×6000, 304
		pull rope sensor	10M 4-20MA
		airbag installation assembly	
5	Compressor	compressor	8.5M3/MIN
		metal hose	JRD25 DN25 L=500MM , 304
		pressure sensor	0~4.0MPa
		temperature sensor	-50~200℃
		pneumatic angle seat valve	DN15, 304
6	Cold dryer	cold dryer	8.5M^3/M, 304
		manual ball valve	DN50, 304
		pressure sensor	0-4.0MPa
		temperature sensor	0-300℃

7	Adsorption and drying tower	adsorption, drying tower	Φ600×2000, 304 surface passivation
		heater	15KW
		activated carbon	CH-18 φ4-φ6, coconut shell
		desiccant	4A φ5
		filter	304
		pneumatic ball valve	DN50, 304
		temperature sensor	0-300℃
		self-operated pressure reducing valve	DN20
8	Refrigerator	water-cooled screw unit	1000KG/H 120KW
		shell and tube water cooler	
		CO2 condenser	90M2, 304
		pressure transmitter	0-4.0MPA, 304
		pneumatic ball valve	DN50, 304
		pressure gauge	0-2.5MPA
		check valve	DN25
		safety valve	A21W-40P DN20, 304
9	Purification	purification tower	Φ300 L=5000, 304
		reboiler	Φ450, 304
		filler	304
		liquid level gauge	400MM
		shielded pump	5T/h lift 30M, 304
10	Liquid storage tank	vacuum storage tank	50m3 ×3, 16MnDR
		Differential pressure level	
		manual ball valve	DN25
		pressure gauge	YXC-100Z 0~1.0MPa
		safety valve	A21W-40P
11	Electronic control part	programmable controller, module	S7-smart SR40
		industrial computer	
		other electrical components	

		control software with independent intellectual property rights	

6. Detail introduction of each system in this plant

6.1. Overview

This recovery device consists of dilute alcohol recovery, scrubber, pre-adsorption, air storage bag, compression, cold dryer drying and purification, adsorption, molecular sieve drying, liquefaction, purification, storage and filling, tank truck filling, cylinder filling and other units. It is used to recover the carbon dioxide generated during the fermentation process and purify it for use. The specific process flow is as follows:

The carbon dioxide gas produced during the fermentation process first enters the dilute alcohol recovery system, which not only removes impurities such as alcohols and lipids in the CO2 gas, but also recovers alcohol. When the alcohol concentration in the circulating water tank reaches 3%, the dilute alcohol can be recovered. The CO2 gas then flows into the scrubber, where the alcohol, suspended particles in the gas and impurities dissolved in water are further washed away. After twice water washes, the carbon dioxide gas enters the two-stage parallel pre-adsorption tower, which are used in turn. The pre-adsorption tower is filled with high-performance activated carbon to further adsorb the organic molecules contained in the CO2 gas. At this time, the relatively pure CO2 is compressed to 2.0Mpa with the help of a

two-stage oil-free lubricated carbon dioxide compressor. In order to ensure the stable operation of the carbon dioxide compressor, an air bag is set between the pre-adsorption tower and the carbon dioxide compressor. The compressed gas is purified by the cold dryer, adsorption tower and drying tower, and the purified carbon dioxide gas is condensed into a liquid at -20℃ in the carbon dioxide condenser; the cold source of the condenser is provided by the condensing unit. Liquid carbon dioxide is pumped into the gas stripping tower and reboiler through a shielded pump and finally into a storage tank for storage. When users sell carbon dioxide, they can fill it into a tank truck through a filling pump, or they can pressurize it into a cylinder through a CO2 filling pump.

6.2. Equipment composition

6.2.1 Washing unit

This unit is mainly composed of scrubber tower, dilute alcohol tank, circulating pump, magnetic flap level gauge and valve pipelines. The scrubber tower, dilute alcohol tank and circulating pump are the main equipment of this unit.

6.2.2 Water scrubber tower

This unit is mainly composed of water scrubber tower, magnetic flap level gauge, various valves and pipelines.

The water scrubber tower is a main equipment of this unit. It is a stainless steel low-pressure packing tower corrugated plate. Carbon dioxide gas flows from bottom to top, and the washing water is sprayed down from the top of the tower. The gas is fully in contact with the washing water, so that the suspended particles and other rough impurities in the raw gas in the water washing tower are washed away.

6.2.3 Pre-adsorption unit

This unit is mainly composed of two parallel adsorption towers, valves and pipelines. The two parallel adsorption towers are switched to ensure the continuous operation of the entire device. The compressed carbon dioxide gas is removed from residual sulfides and volatile compounds (acetaldehyde, mercaptan), water and other impurities in the adsorption tower.

6.2.4 Air storage bag

This unit is mainly composed of air storage bag, air bag bracket, pull rope displacement sensor, etc.

The air storage bag is the main equipment of this unit. It is set between the water scrubber and the compressor. Its function is to compensate for the change of raw gas, play a buffering role, and stabilize the suction pressure of the compressor to ensure the smooth operation of the compressor.

6.2.5 Compressor unit

The main equipment of this unit is the oil-free lubricated carbon dioxide compressor, which consists of compressor main unit, air intake filter assembly, primary separator assembly, secondary separator assembly, oil filter assembly, cooler assembly and safety valve assembly. The carbon dioxide gas is compressed in two stages and the pressure is increased to 2.0Mpa.

6.2.6 Cooling and cleaning unit

The cold and cleaning unit is mainly based on the principle of refrigeration and dehumidification. The compressor gas is cooled by heat exchange through the evaporator, so that the water vapor in the compressed gas is cooled by isobaric cooling and condensed into liquid water, which is discharged from the system by the drainer, making the compressed CO2 gas purer. During operation, the drainer realizes automatic drainage, and the cold dryer and the CO2 compressor are interlocked and automatically opened.

6.2.7 Adsorption drying unit

This unit is mainly composed of two sets of parallel adsorption drying towers, pressure gauges, valves and pipelines. The two parallel adsorption drying towers are switched to ensure the continuous operation of the entire device. The compressed carbon dioxide gas is removed from residual sulfides and volatile compounds (acetaldehyde, mercaptan), water and other impurities in the adsorption drying tower.

The adsorption drying tower is a stainless steel pressure vessel with a pressure of 2.5Mpa. The lower part is filled with CH-28 or CH-18 granular (spherical or cylindrical) activated carbon adsorbent, and the upper part is filled with 5A spherical

molecular sieve desiccant. In order to prevent activated carbon powder and desiccant powder from entering the system and blocking valves and pipelines, stainless steel filters are installed at the upper and lower parts of the adsorption drying tower, i.e., the gas inlet and outlet.

The two adsorption drying towers work alternately, and the working time of each tower is 24 hours. One tower is working while the other tower is regenerating. The activated carbon and molecular sieve regeneration is returned to the heater with the help of purified carbon dioxide gas, and the carbon dioxide gas is heated in the heater. The heating temperature is 110-160℃, and the adsorption drying tower is cooled with CO2 gas to room temperature.

6.2.8 Refrigeration unit

This unit consists of a screw refrigeration compressor unit (carbon dioxide condenser), various valves and pipelines.

⑴ The screw refrigeration compression condensing unit is mainly composed of screw refrigeration compressor, vertical condenser, liquid receiver, gas-liquid separator, etc.

⑵ Carbon dioxide condenser

The carbon dioxide condenser is a tube-and-tube heat exchanger. The shell side is carbon dioxide gas, with a pressure of 2.5Mpa; the tube side is the refrigerant R22. R22 is compressed by the compressor and enters the tube side of the carbon dioxide condenser through the expansion valve. R22 absorbs heat and evaporates in the tube side; carbon dioxide absorbs cold in the shell side and is liquefied. The liquefied carbon dioxide liquid flows into the carbon dioxide storage with the help of the liquid level difference.

6.2.9 CO2 purification unit

The carbon dioxide purification device includes reboiler and purification tower. Before the gas is liquefied, it first passes through the reboiler to vaporize the liquid in it to obtain a higher purity gas. It moves from bottom to top along the purification tower and contacts the liquid from the liquefier in the purification tower from top to bottom. The liquid forms a liquid film in the purification tower packing (imported high-efficiency stainless steel packing). When the gas passes through the liquid film,

mass transfer occurs. The impurities in the carbon dioxide are transferred from the high concentration side to the low concentration side. After repeated cycles, the purpose of liquid purification is achieved. The purification system plays a distillation role here, without adding additional energy consumption, thereby ensuring the high purity of the carbon dioxide liquid entering the liquid storage tank. When the carbon dioxide liquid accumulated in the reboiler reaches a certain liquid level, it is automatically transported to the liquid storage tank by a variable frequency shielded pump. The start and stop of the shielded pump is automatically controlled by the liquid level.

6.3.0 Storage Tank

This unit is mainly composed of carbon dioxide storage tank and valves. The carbon dioxide condenses and liquefies into a carbon dioxide liquid that enters the tank for storage. The carbon dioxide tank is a low-temperature pressure vessel. In order to facilitate the monitoring of the liquid carbon dioxide level in the tank, a weighing device is installed to observe the weight of carbon dioxide in the tank at any time, and to control the upper limit of the carbon dioxide liquid level in the tank and automatically send out an alarm signal. In order to ensure the safe operation of the tank, a pressure vessel, a safety valve, a pneumatic ball valve and a manual ball valve are installed to vent; if the tank is over-pressured, the pneumatic ball valve is controlled by an electric contact pressure gauge to vent, and when the pressure drops to a certain value, the pneumatic ball valve automatically closes. If the tank is over-pressured and the pneumatic ball valve and safety valve do not work, a manual ball valve is used to vent. In this way, there are three valves to ensure the safe operation of the pressure vessel.

6.3.1 Electrical control unit

PLC and touch screen are the main equipment of this unit.

The programmable controller combined with the touch screen is used for control, making the operation simpler and more intuitive. All working conditions of the equipment are displayed in the form of graphics or Chinese menus in front of the operator, and the automatic and manual operation interfaces and fault screen history

records are clear at a glance. Closed-loop control is adopted for all control points to realize the system fault self-diagnosis function, that is, various automatic valves and motors of the system are fed back to the PLC in the form of switch quantities, so that the PLC can detect the switch status of various valves, the start and stop of the motor at any time. When the system is running normally, this information is clearly displayed on the simulation screen. Once a part of the system fails, the touch screen will switch to the fault display screen and directly display the fault part, the cause of the fault or which device has failed in Chinese, which is convenient for equipment maintenance and improves the maintenance speed of the equipment.

7. Machine pics