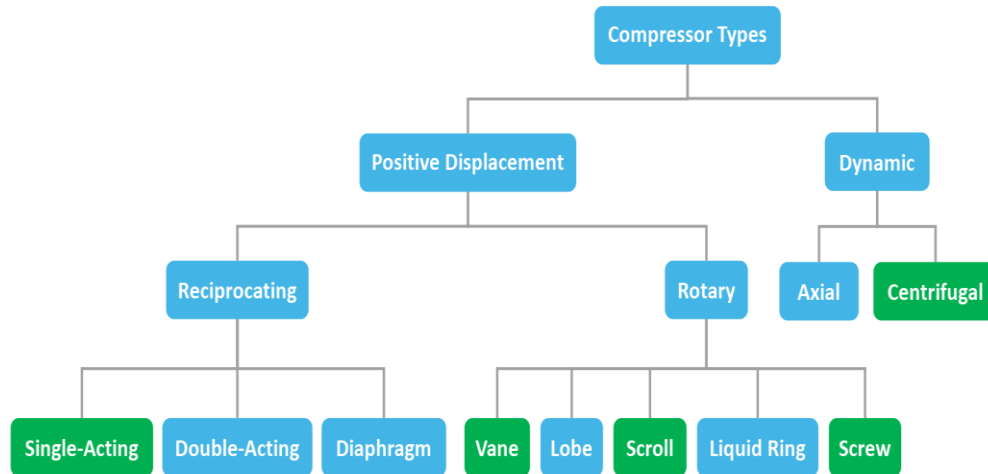


Types of refrigeration compressors and solution of using high-efficiency compressors in seafood processing factories

1. Classification of refrigeration compressors

Refrigeration compressors are widely used in air conditioning and freezing systems in various fields such as seafood processing, beer-wine-beverage, milk processing, frozen food cold storages.

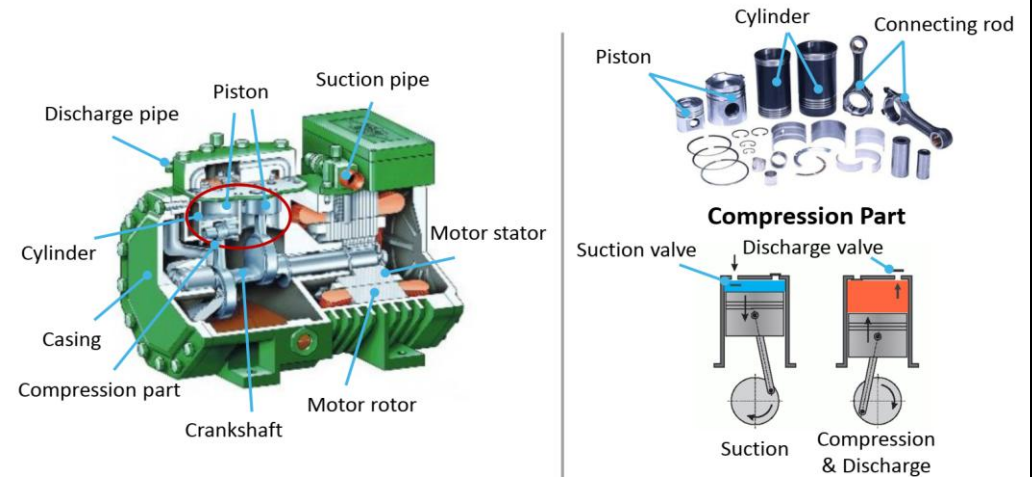
The compressor acts as the "heart" of the refrigeration system. The function of a compressor is to suck refrigerant vapor from evaporators and compress it from low pressure and temperature to high pressure and temperature.



Classification of refrigeration compressors

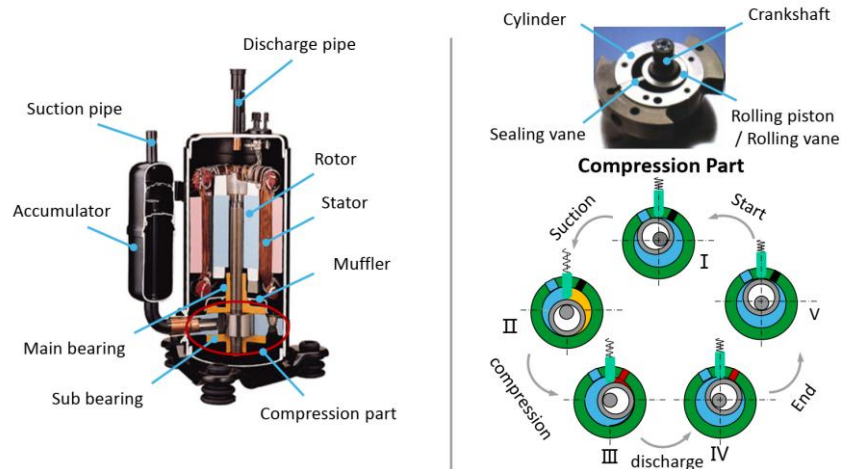
2. Types of refrigeration compressors

❖ Reciprocating compressor

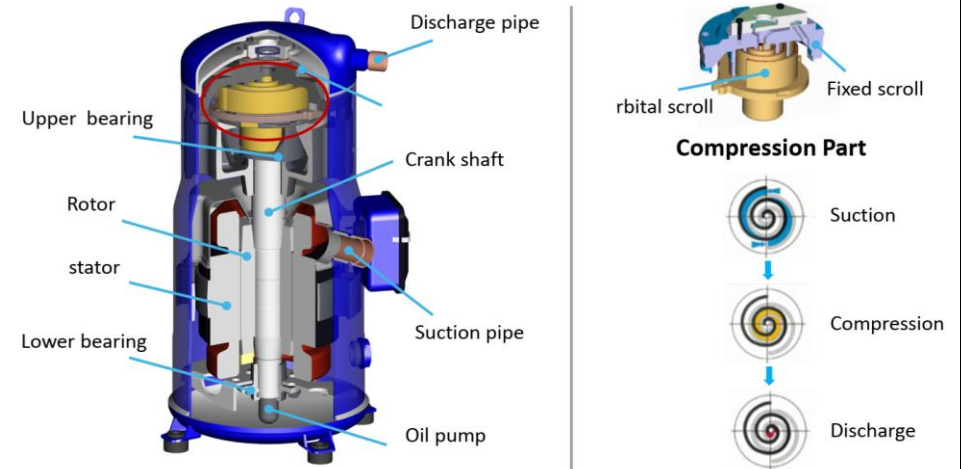


Advantages	Disadvantages	Application
<ul style="list-style-type: none">• Capable of compressing a variety of gases such as refrigerant, hydrogen, and natural gas• Wide power range: residential and commercial air conditioning applications.	<ul style="list-style-type: none">• Low energy efficiency• Sensitive to liquids• Greater size and weight per power unit compared to other compressors• Difficult to maintain• High vibration	<ul style="list-style-type: none">• Home refrigerators and freezers• Residential and commercial refrigeration & air conditioning applications

❖ Rotor compressor



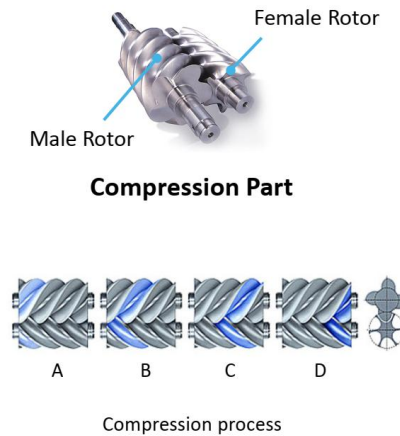
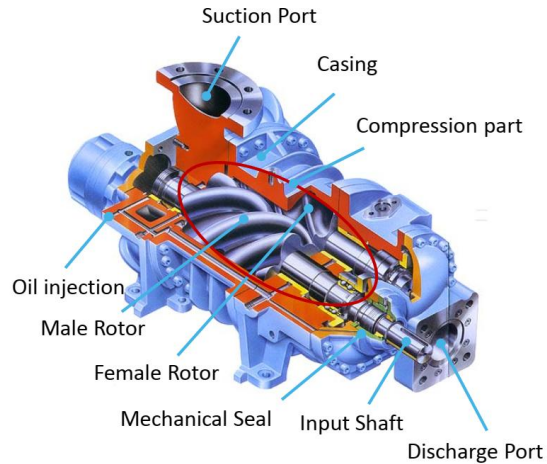
❖ Spiral compressor



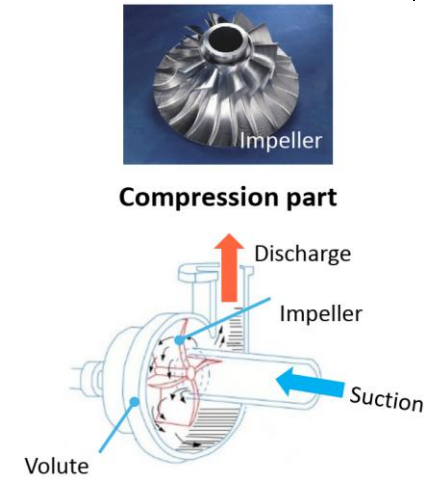
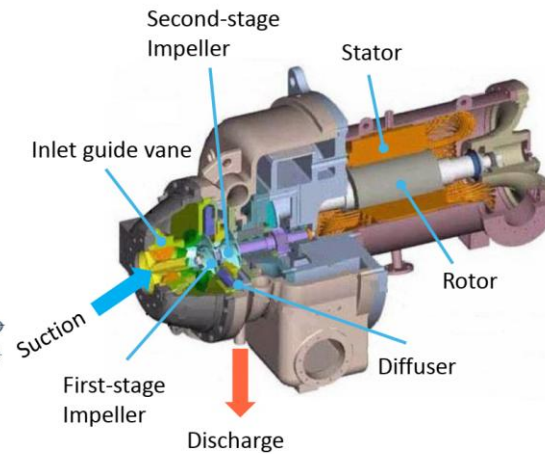
Advantages	Disadvantages	Application
<p>In comparison with reciprocating compressor:</p> <ul style="list-style-type: none"> • Higher efficiency • Smaller size and lighter weight per power unit (40% -50% saved). • Less vibration 	<ul style="list-style-type: none"> • Small power range, usually below 18 kW due to structural limitations. • Lower energy efficiency than other types of compressors (helical compressors, screw compressors, and centrifugal compressors) 	<ul style="list-style-type: none"> • Home refrigerators and freezers • Air-conditioning products and residential heat pumps below 18 kW

Advantages	Disadvantages	Application
<p>In comparison with reciprocating and rotor compressors:</p> <ul style="list-style-type: none"> • Higher reliability due to simpler structure and less detail. • Higher efficiency due to fewer losses. • Less vibration and spillage due to the continuous movement of gas through the sweeping motion of the rotor. 	<ul style="list-style-type: none"> • Lower efficiency and smaller capacity than screw and centrifugal compressors. 	<ul style="list-style-type: none"> • Residential and commercial refrigeration & air-conditioning applications require a compressor capacity of less than 35 kW

❖ Screw compressor



❖ Centrifugal compressor



Advantages

In comparison with reciprocating, spiral and rotor compressors:

- Simple structure, less component, greater capacity and higher efficiency
- Less vibration and spillage due to the continuous movement of gas through the sweeping motion of the rotor.
- Better cooling capacity adjustment without causing unstable operation,
- Less sensitive to liquids

Disadvantages

- No power range of less than 70 kW

Application

• Screw compressors were developed to compete with large reciprocating compressors and small centrifugal compressors in both the air-conditioning and refrigeration markets. It is used for commercial and industrial refrigeration and air conditioning applications with power range from 70 kW to 2,637 kW.

Advantages

In comparison with the above types of compressors:

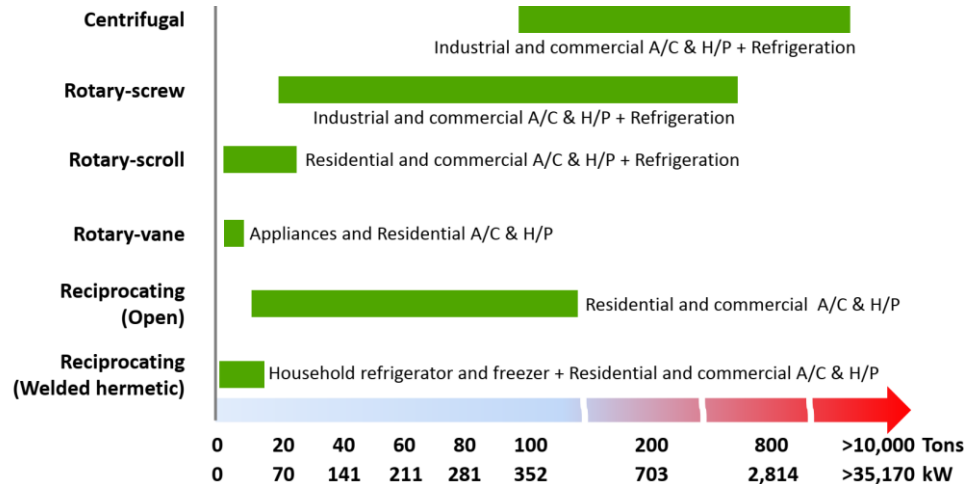
- Large capacity of up to 35,000 kW
- Better under-load performance
- The heat transfer coefficient in the evaporator and condenser is higher due to the oil-free refrigerant.
- Compact structure and lighter weight per power unit.
- Higher reliability and lower maintenance costs thanks to fewer wear-and-tear components.
- Less vibration.

Disadvantages

- Higher investment costs, but lower operating costs.
- Need higher quality materials, higher precision machining and higher quality production.
- No power range of less than 70 kW

Application

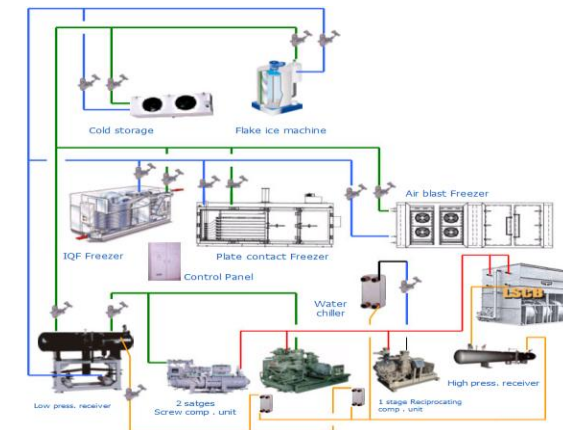
• Centrifugal compressors are best suited for large refrigeration applications of over 700 kW and are the most common type of compressor for commercial and industrial refrigeration and air conditioning systems. It competes with large capacity screw and reciprocating compressors.



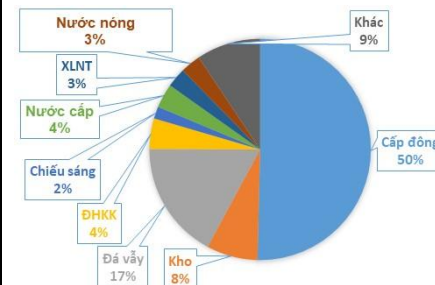
Compressor Types		Cost per kW	Efficiency	Vibrations	Manufacturing accuracy	Input power per unit
Positive displacement	Reciprocating Single-acting	Low	Low	High	Easy	Low - High
	Rotary-vane	Medium	Medium	Moderate	Difficult	Low
	Rotary-scroll	Medium	High	Moderate	Difficult	Low
	Rotary-screw	High	Very high	Lowest	Very difficult	High
Dynamic	Centrifugal	High	Very high	Lowest	Very difficult	High

In comparison with refrigeration compressors

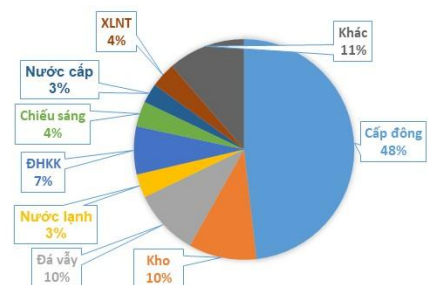
The refrigeration system is an important component used for freezing or preserving products in the food processing industry such as seafood processing plants and cold storages. Refrigeration systems account for a large proportion (from 50% to 60%) in the total electricity consumption of seafood processing factories.



Refrigeration system in seafood processing factories



Fish processing factory



Shrimp processing

Source: IFC - ENERTEAM, 2011

Refrigeration systems in many seafood processing plants still use reciprocating refrigeration compressors with low cooling efficiency, and thereby causing waste of electricity. Currently, modern seafood processing factories have gradually replaced reciprocating refrigeration compressors with high efficiency screw compressors, but in a small scale due to high investment costs.

However, with the technological development and the need to reduce

	energy costs for production, the screw compressor is an essential technological solution to reduce the emissions into the environment and saving energy.
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