

Introduction to Test Plant Facilities

At our technical center in Japan we offer a R&D and pilot plant testing center where our customers can verify the feasibility of the proposed equipment, prepare samples for research, quality validation and marketing as well as have accurate data in order to help our customers to make a safe investment choice.

Feel free to contact our sales team for detailed information.



OKAWARA

Head Office, Technical Center & Factory

1235, Kando, Yoshida-cho, Haibara-gun, Shizuoka-ken,
421-0304 - JAPAN

Phone: +81 548 32-3211 Fax: +81 548 32-9844

Email: info@okawara.co.jp

www.okawara-mfg.com

* As a result of continuous improvement, technical parameters, design, dimensions, etc., can be changed without prior notice.



ISO 9001 Certified

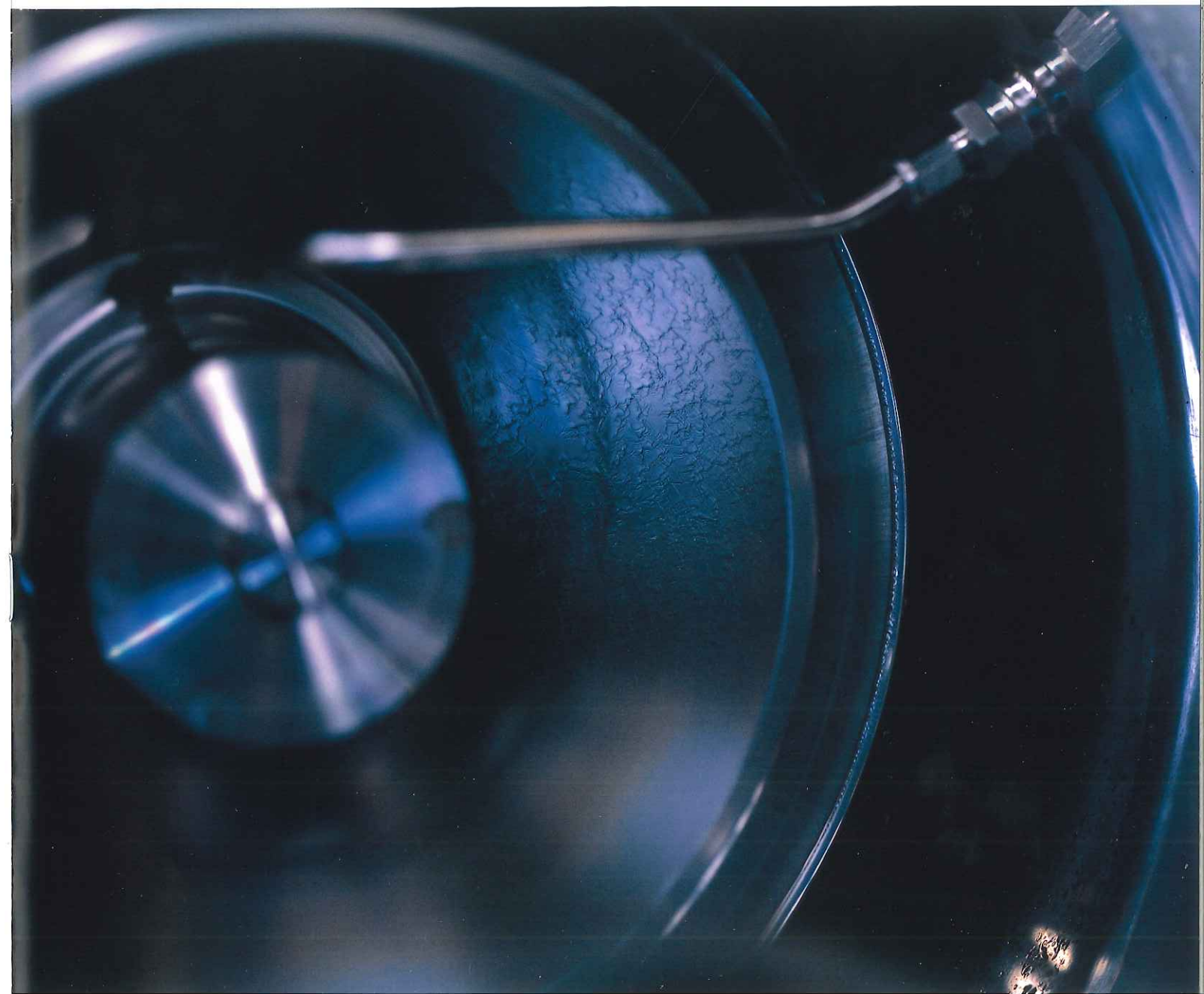
OKAWARA

Spinning Cone Centrifugal Thin-film Vacuum Evaporator

EVAPOR

Low temperature evaporation, short product residence time,
high concentration rate, hygienic design, high heat transfer
coefficient, processing flexibility.

EVAPOR is the ideal technology for concentration of
heat sensitive and high value products.



Ultrarapid heat transfer for fast concentration with minimal thermal deterioration and loss of functionality of active ingredients

OUTLINE

EVAPOR is a single effect, thin-film centrifugal evaporator that works under vacuum. The system consists of a hollow disc cone rotating on a horizontal cantilevered shaft and uses steam as heating medium. EVAPOR is particularly suited for the processing of heat sensitive, viscous and valuable products.



Spinning cone housing can be easily open in order to facilitate inspection and cleaning

OPERATING PRINCIPLE

The material to be concentrated is pumped into the equipment through a feed tube that delivers the liquid right in the bottom of the spinning cone. Centrifugal force created by the spinning cone spreads the liquid out over the entire heating surface in a very thin liquid layer (≤ 0.1 mm), passing across the heating surface in a very short time - less than one second. The material is instantly heated to the boiling point temperature which is controlled by the operating pressure (vacuum) in the system. The concentrated material is then collected at the periphery of the spinning cone by a stationary paring tube and pumped out of the equipment while the product vapor will flow to a condenser where it will get condensate and then get discharged by a condensate pump.

Speedy and uncomplicated change of feed products allied with easy cleanability make the EVAPOR an excellent choice for processing of multiple products.

SOME APPLICATION EXAMPLES

PHARMACEUTICALS, NUTRACEUTICALS, COSMETICS

- | | | |
|---------------|---------------------|----------------------|
| ● Antibiotics | ● Vitamins | ● Injectables |
| ● Penicillin | ● Herbal medicine | ● Elastin |
| ● Enzymes | ● Active substances | ● Fermentation broth |
| Others | | |



FOOD AND BEVERAGES

- | | | |
|------------------|-----------------------|--------------------|
| ● Flavors | ● Seasonings | ● Natural extracts |
| ● Fermented milk | ● High quality juices | ● Specialty oils |
| ● Tea and coffee | ● Dairy products | ● Proteins |
| Others | | |



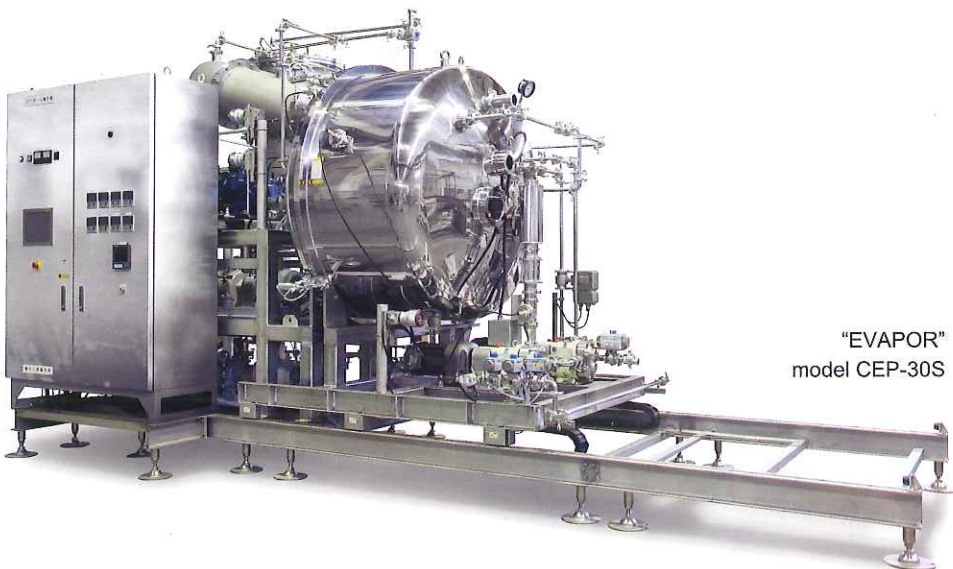
CHEMICALS

- | | | |
|-------------------|---------------------|------------------------|
| ● Fine chemicals | ● Silica | ● Polymers |
| ● Solvent removal | ● Manganese nitrate | ● Nitric acid |
| ● Iodide solution | ● Diethyl ether | ● Cellulose triacetate |
| Others | | |



BENEFITS

- Suitable for product quality improvement of heat sensitive, viscous, high value products to a degree not possible to be achieved by conventional evaporators.
- Very short contact time: the product takes less than a second to pass over the heating surface avoiding the product to be overexposed to heat.
- Low evaporation temperature (from 35°C) to ensure minimal to no degradation of products where flavor, color and functionality are a must.
- Highest level of hygienic design for good cleanability.
- The centrifugal design helps the EVAPOR to produce concentrates with considerable higher soluble solids level and higher viscosity than traditional evaporators as well as to ensure product quality improvement.
- Low hold-up volume: the film thickness on the spinning cone is generally around 0.1mm, resulting in only few liters of product being held-up within the system and virtually no product loss between batches.
- Capacity to achieve high concentration rate in a single pass.
- Foam generation is minimized by centrifugal force.
- Excellent choice for processing of multiple products thanks to its hygienic design and easy cleanability.
- Compact design: EVAPOR has a small heat transfer surface in relation to its heat transfer capacity, therefore resulting in a compact design with the capability to evaporate far more water per unit area than traditional evaporators and at a fraction of the time.



"EVAPOR"
model CEP-30S

FEATURES

In case of products susceptible to heat denaturation, thermal treatment such as evaporation and enrichment must be performed quickly, at low temperature and with the required coefficient of heat transfer. EVAPOR is able to satisfy all those requirements thanks to the synergistic combination of the following features:

VACUUM OPERATION

EVAPOR uses vacuum conditions to lower the boiling point of the liquid material and therefore the evaporation temperature. There is virtually no temperature increase due to static head pressure resulting from the thin film liquid.

HEAT TRANSFER BY DROPWISE CONDENSATION

The saturated steam (heating medium) is supplied to the spinning cone heating jacket, transferring its energy (latent heat) through the heating surface to the product. After heat transfer the steam briefly condenses however it is immediately shaken off by centrifugal force leaving the heat transfer surface clean and dry at all times, improving heat transfer through dropwise condensation. Dropwise condensation occurs when a vapor condenses on a surface not wetted by the condensate and is known to be the most effective method of heat transfer achieving much higher heat transfer coefficients than those found with film condensation.

This feature is one of the keys for EVAPOR rapid, low temperature processing performance

ENFORCED DISCHARGE OF CONCENTRATE DUE TO CENTRIFUGAL FORCE

The concentrate material is collected at the periphery of the spinning cone by a stationary paring tube and led off via a sight glass to provide a visual inspection of the concentrate prior to it being discharged by the pump. The concentrate when collected for discharge, has about 200 times the centrifugal force of gravity. This feature means that EVAPOR can handle high viscosity products, achieve higher concentration level than traditional evaporators as well as to ensure product quality improvement.

THIN LIQUID FILM FORMED BY CENTRIFUGAL FORCE

The centrifugal force created by the rotational velocity of the spinning cone spreads the liquid out over the entire heating surface in a very thin liquid layer of approximately 0.1mm thick. The residence time of the product on the heat transfer surface is extremely short – less than a second – ensuring that minimal to no impact on flavor, color, and active ingredients to a degree not possible to be achieved by conventional evaporators. The application of centrifugal force also helps to prevent the effects of high viscosity as well as minimize generation of foam in a more effective way than falling film or wiped/scraped film evaporators. Furthermore, EVAPOR has no moving parts such as mixing or scrapping blades on the heat transfer surface easing cleaning and eliminating any potential fear of contamination by foreign matters produced by abrasion or friction.

EXCEPTIONAL HEAT TRANSFER EFFICIENCY

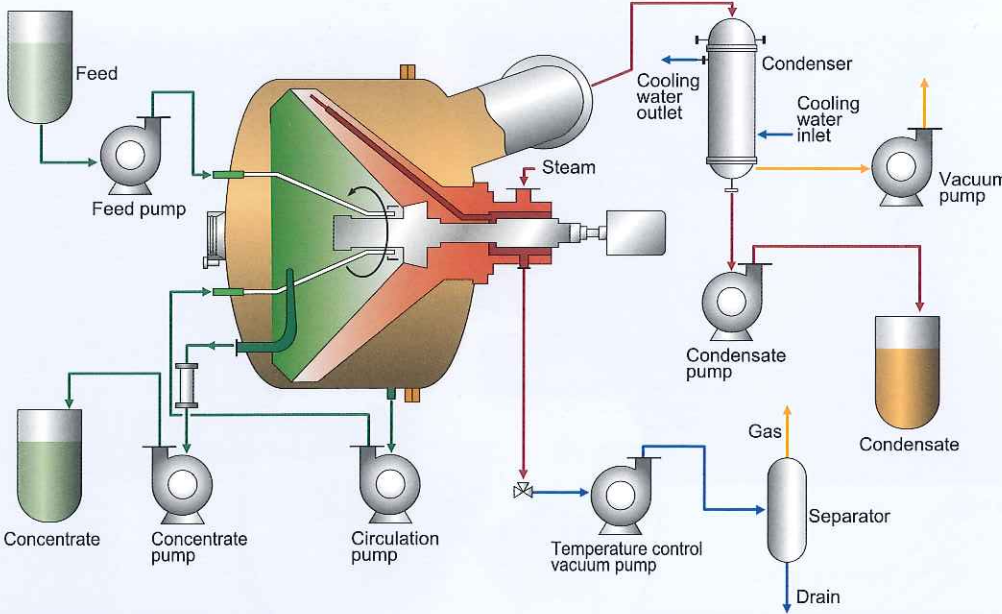
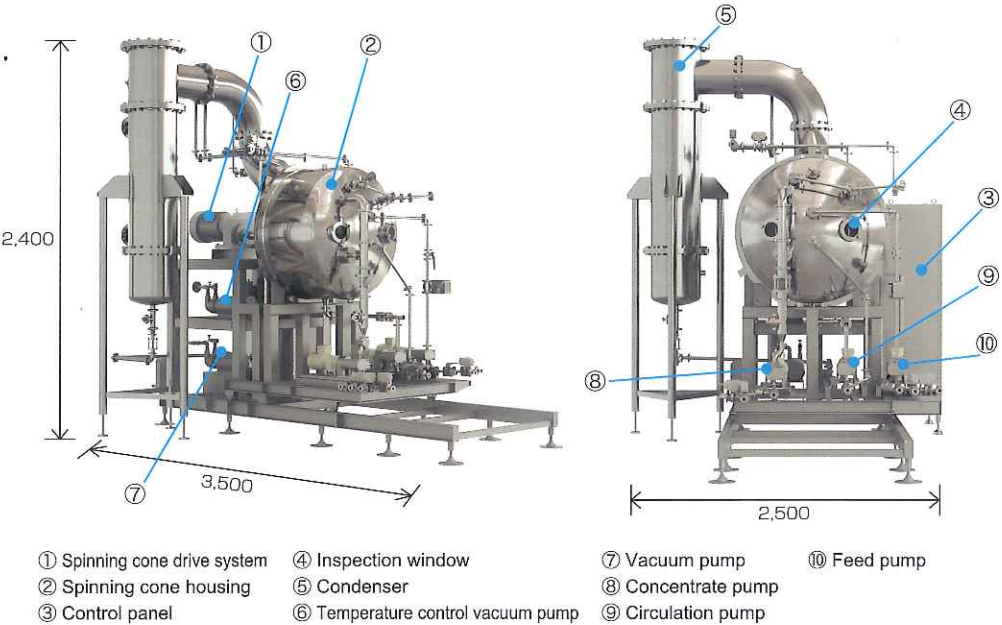
The spinning cone heat transfer surface is spin draw from very thin (1mm) stainless steel plates adding differences in level to the plates in order to diminish the product pressure resistance and enhance its heat transfer. The thin plate heating surface allied with the extremely high heat transfer coefficient of the liquid film and steam condensate makes it possible to achieve an overall heat transfer coefficient of 5,000 to 9,000 W/m² K (for water evaporation). The required heat transfer surface is small in relation to the heat transfer capacity, thus leading to a compact design.

DESIGNED FOR EASY OPERATION

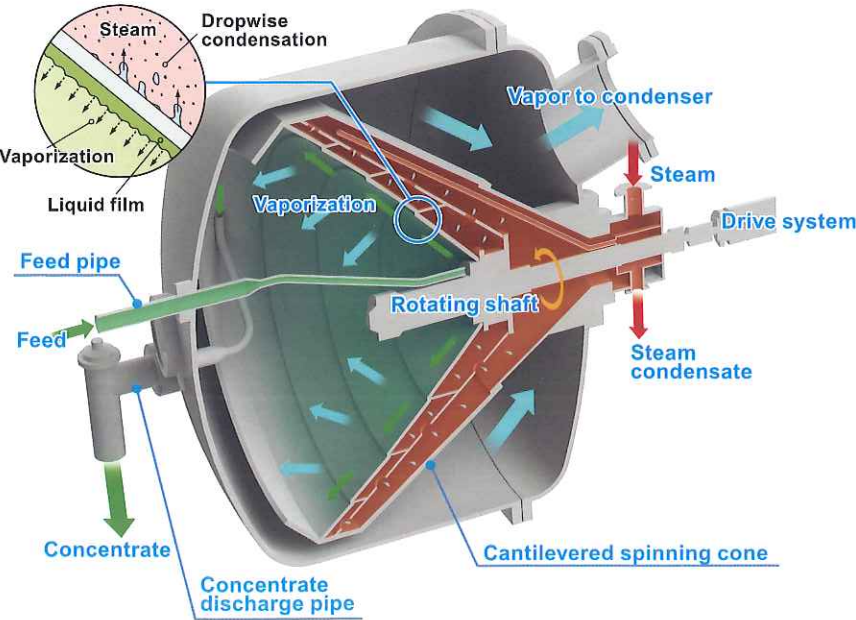
The inspection windows placed on the spinning cone front housing permit supervising of the evaporation process whilst in progress, enabling the monitoring and evaluation of the evaporation characteristics of the product. The spinning cone housing can be easily opened for cleaning and inspection. The design according to GMP guidelines guarantees that residuals can be fully drained. Condenser can be easily washed. Effective CIP cleaning line can be provided to satisfy higher hygienic applications. Evaporation temperature of the system can be easily changed depending on the heat sensitivity of the product. Speedy and uncomplicated changeover of feed products allied with easy cleanability and minimal to no loss of product between batches make the EVAPOR an excellent choice for processing of multiple products.

LAYOUT DIAGRAM

CEP-10S

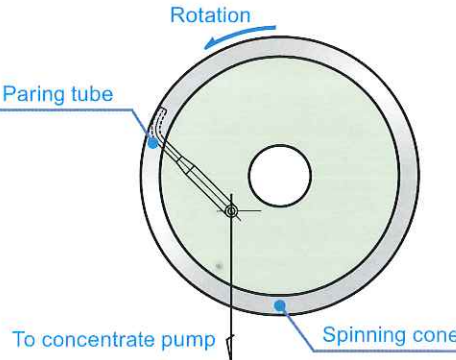


STRUCTURE DIAGRAM



Concentrate discharge mechanism

The concentrated liquid collected at the periphery of the spinning cone is driven into the pairing tube by hefty centrifugal force.



Item	Model	CEP-1	CEP-5S	CEP-10S	CEP-20S	CEP-30S
Evaporation surface (m ²)		0.1	0.4	1.0	1.7	2.7
Evaporation capacity (kg/hr) *		70	200	420	750	1,200
Spinning cone rotational speed (min ⁻¹)		1,500	800	500	400	400
Utilities	Steam (kg/hr)	85	240	500	900	1,450
	Power (kW) **	10.2	19.45	21.7	23.9	23.9
	Compressed air (NL/min)	70	100	100	100	100
	Seal water (L/min)	10	10	15	16.7	16.7
Cooling water (m ³ /hr)		8	23	48	86	138
Sizes **	Length (mm)	1,650	3,000	3,500	4,500	4,700
	Width (mm)	1,100	2,300	2,500	2,600	3,100
	Height (mm)	1,850	2,400	2,400	2,800	3,200

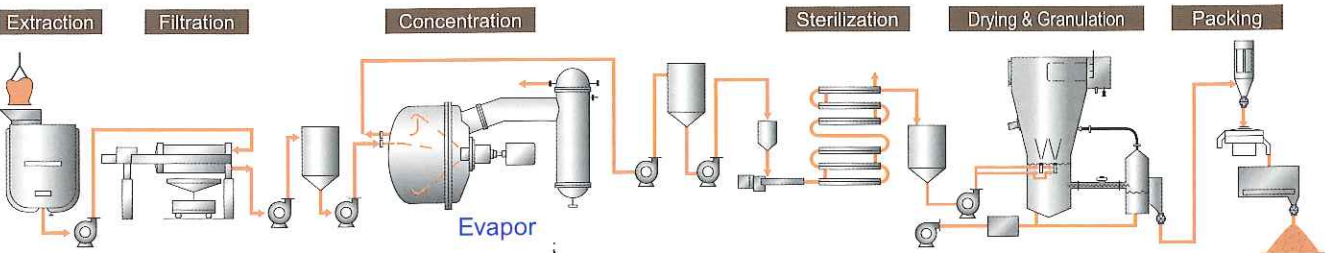
* Pure water evaporation at 100°C heating temperature and 40°C evaporation temperature

** Values for reference only

Extensive experience and expertise in design, engineering and construction of production plant systems tailored to customer's requirements.

EXAMPLE OF EVAPOR APPLICATION IN A GREEN TEA EXTRACTION PLANT

In order to produce high-value products, extraction plant has been designed to achieve maximum yield with the highest sanitary and quality standards. The extraction plant is currently operating successfully and in accordance to the customer's opinion the employment of "EVAPOR" was one of the reasons for that.



Extraction tank



EVAPOR & concentration tank



Spray Drying



Sterilization

Compact design suitable for lab, R&D, sample production, small scale production or scale-up applications.

EVAPOR lab

EVAPOR lab is the laboratory version of EVAPOR. It is specially designed for research and development of products, manufacturing of samples, small batches and validation of process parameters.

HIGHLIGHTS

- Same features as production models
- Superior performance than conventional glass rotary evaporators
- Ideal for research centers and universities
- Reliable scale-ups
- Hygienic design
- Simple operation
- Plug in package unit
- Compact system design
- Mobile housing mounted on casters

SPECIFICATIONS

Item	Model	CEP-lab
Evaporation surface (m ²)		0.05
Evaporation rate (kg/hr)		30 (pure water) (Heating temp : 80°C Evaporation temp : 40°C)
Heating temperature range		60°C to 100°C
Evaporation temperature range		35°C to 100°C
Spinning cone velocity (min ⁻¹)		1,500
Heating surface material		SUS316
Cabinet material		SUS304
Condensate tank (L)		15
Utilities	Steam (kg/hr)	0.1MpaG, Max.40kg/hr
	Power (kW)	5.05* (three-phase)
	Compressed air (NL/min)	10*
	Seal water (L/min)	20*
	Cooling water (m ³ /hr)	2.5 (20→32°C)*
Dimensions*	Length (mm)	1,200
	Width (mm)	1,500
	Height (mm)	1,700

Non-explosion proof design only
*Values for reference only



Evaporation Rate Curve

