

دستگاه چند منظوره سیال فوق بحرانی کربن دی اکسید

## Supercritical Carbon Dioxide Multi Purpose Apparatus (SC-EMP300)



Apex technologies co., designed and manufactured a supercritical fluid extraction equipment for different purposes including extraction of essential oils, removal of contaminations from soil (cleaning purposes), regeneration of spent catalysts and fabrication of sub-micron and nano size pharmaceuticals or any soluble substance in SC-CO<sub>2</sub>. Supercritical fluid is any substance at a temperature and pressure above its critical point. Such fluids can diffuse through solids like a gas and dissolve materials like a liquid. Near the critical point, small changes in pressure or temperature result in large changes in density, allowing many properties of a supercritical fluid to be “fine-tuned”. Supercritical fluids are often suitable substitutes for organic solvents in a range of industrial and laboratory processes. Among the different possible solvents, carbon dioxide is one of the most common used supercritical fluids mainly due to its mild critical point (31 °C, 1057 psi).



The current equipment is comprises of three different Interchangeable extraction Vessels of 100, 300, 500 and 1000 ml (with 5 micron frits). These extraction vessels can be combined with a surge tank with volume of 1000 cc to dampen the pressure fluctuations due to pulses manufactured by water driven oil-free reciprocating Haskel pumps coupled with a nitrogen capsule for automatic pressurization. In addition, an integrated program logic controller monitors and adjusts fluid pressure inside the extraction vessel to achieve and maintain a desired set point. The carbon dioxide supplied from capsule is liquefied using a refrigeration system with a minimum temperature of  $-25\text{ }^{\circ}\text{C}$ . the equipment is provided by two high pressure single pump enable the operator to inject different co-solvents using these two high pressure pump wit minimum flow rate of 0.01 cc/min (minimum displaced volume of 0.001 cc) up to pressure of 10000 psi. The temperature of all the vessels including surge tank and extraction vessels are controlled using slim heating elements implanted inside the vessels wall coupled with a PT-100 thermocouple. As a safety precaution, safety valves provide mechanical protection against accidental over-pressurization of the system was installed in-line

For the last point of this equipment, two sight glasses is added to one of the extraction vessels enable operator to monitor the phase behavior and variation using a CCD camera equipped with a macro Computer lens. The worth mentioning point must be noticed is the application of inner nozzle inside the extraction vessels to spray the carbon dioxide into the packed bed to avoid any channeling inside the packed bed which reduce the efficiency and may lead to caking of the packed bed.

#### *Technical Specifications:*

- ✓ Applicable to investigate the effectiveness of supercritical carbon dioxide on deactivation of spent catalyst or removing any polar or non-polar contaminations
- ✓ Applicable in drug delivery, drug engineering, etc. by micronizing the solid particles using rapid expansion of supercritical solution
- ✓ Extraction vessel is equipped with two sight glasses enable the operator to monitor the contents of the vessel

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- ✓ Transfer vessel for co-solvent injection × 1 (volume of transfer vessels: 100 cc made of stainless steel 316)
- ✓ HP-HT metering valve to control the output flow ×1 (BuTech/hoke/Autoclave/Vinci type valve)
- ✓ Tuneable spraying distance system × 1 (variable from 1 cm to 15 cm)
- ✓ Applicable to extract essential oils from herbs and seeds and etc.
- ✓ Oil-free air driven reciprocating Haskel/Maximator pump × 1
- ✓ Maximum working temperature of extraction vessel: 100 oC
- ✓ Main process valves: BuTech/Autoclave/Vinci type valves
- ✓ Maximum working pressure of extraction vessel : 300 bar
- ✓ Minimum temperature of refrigeration system: -20 oC
- ✓ Minimum carbon dioxide discharge pressure: 750 psi
- ✓ Controlling temperature system × 1: PID control
- ✓ Sampling system for micronization process × 1
- ✓ Connections and plumping: Stainless steel 316
- ✓ Glass rushing rings for packing × 1 package
- ✓ Stainless steel basket to handle the sample
- ✓ Extraction vessel volume × 1: 500 cc
- ✓ Heating mechanism: heating jacket
- ✓ Wetted parts: stainless steel 316
- ✓ Temperature resolution: 0.2 oC
- ✓ liquefaction system × 1
- ✓ Spraying nozzles × 10
- ✓ Collection vessel × 1 (500 cc)
- ✓ Collection vessel pressure: 150 bar
- ✓ Automatic valve for expansion
- ✓ Automatic expansion process
- ✓ Automatic valves: Autoclave, Butech or Swagelok

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- ✓ Touch panel equipped with a software for expansion algorithm
- ✓ High pressure pump to inject co-solvents × 1
  - Pulseless mechanism applicable for different purposes including core flooding processes, injection of fluids into PVT, injection of fluids into high pressure reactors and etc
  - Necessary to inject liquids such as alcohols enhance the solubility power of supercritical carbon dioxide for polar compounds
  - Min. resolution for displaced volume: 0.001 cc
  - Max. pressure of injection: 400 bar
  - Wetted parts: stainless steel 316
  - Min. flow rate: 0.01 cc/min
  - Effective volume: 100 cc
  - Max. flow rate: 7 cc/min
  - Piston cylinder type
  - Compact design

