

# Supercritical CO<sub>2</sub> Extraction



•  
By  
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Chemtron Science Laboratories Pvt. Ltd.

# Do You use Scents?



# Do You use Spices?



# Do You use Herbal Medicines?



# Do You use Herbal Extracts?



**Do you know how these are extracted?**



**Are you looking for alternative way to extract  
various oils, oleoresins and waxes?**



**Well.....Chemtron has solution in the form  
of  
Supercritical CO<sub>2</sub> Extraction System  
The most Ecofriendly Product**



# SUPERCRITICAL CO<sub>2</sub> EXTRACTION SYSTEM



# Introduction to Supercritical CO<sub>2</sub> Extraction System

SCFE System is a green technology machine used to extract essential oils, oleoresins and waxes from the biological materials. Now the system manufacture is economically viable in India.

It is an extremely clean technology as compared to the :

- 1) Solvent Extraction: Is cheap and leaves carcinogens in the extracted materials. Even ppb levels are banned by the Governments.
- 2) Steam Distillation: A simple distillation unit where volatiles are evaporated by heat provided by steam and are separated by cooling and collected in another container. Heat destroys some components of the mixture and we experience change in the smell and colour of the extracted material. Is very lengthy process can take up to 3 days.
- 3) Cold Press: A very cheap method but only 80 % of the material is extracted. Faces Losses
- 4) It is very difficult to carry/store all the herbs and medicines as they occupy large space. It is also very difficult to export these bulky materials. Best way to export these is to extract the contents and export.

# Target Segment

- 1) Pharmaceuticals & Nutraceuticals
- 2) Herbal Extract Manufacturers
- 3) Essential Oil Manufacturers
- 4) Ayurvedic formulation Manufacturers
- 5) Spices and Herbal extract Manufacturers
- 6) R&D Units
- 7) Scent Manufacturers

# What can be Extracted?

- 1) Clove bud Oil
- 2) Ginger root Oil
- 3) Turmeric root Oil
- 4) Sandalwood stem Oil
- 5) Rose wood stem oil
- 6) Rosemary leaves oil
- 7) Lavender dry flower oil
- 8) Cumin Seed oil
- 9) Jatamansi oil
- 10) Khas root Oil
- 11) Policosanol from rice bran oil & sugarcane skin wax .....etc.

There are almost 3500 herbal medicines listed which can be extracted with the help of Supercritical CO2 Extraction System.

# Other Applications

- 1) Oil removal from critical sensitive engineering products
- 2) Oil removal from critical watch parts
- 3) Preparing bones for grafting
- 4) Soil remediation after pollutant spill
- 5) Supercritical enzymatic reaction studies .....etc.

# SCFE System

In SCFE system, CO<sub>2</sub> when heated above 31.1 deg C and pressurized above 70 Bars, becomes a supercritical liquid which is neither liquid nor gas. In this state CO<sub>2</sub> acts as a solvent and this property is utilized to extract various components from biological materials.

Different materials based on their molecular weight are extracted at different temperatures and pressures.



For Example

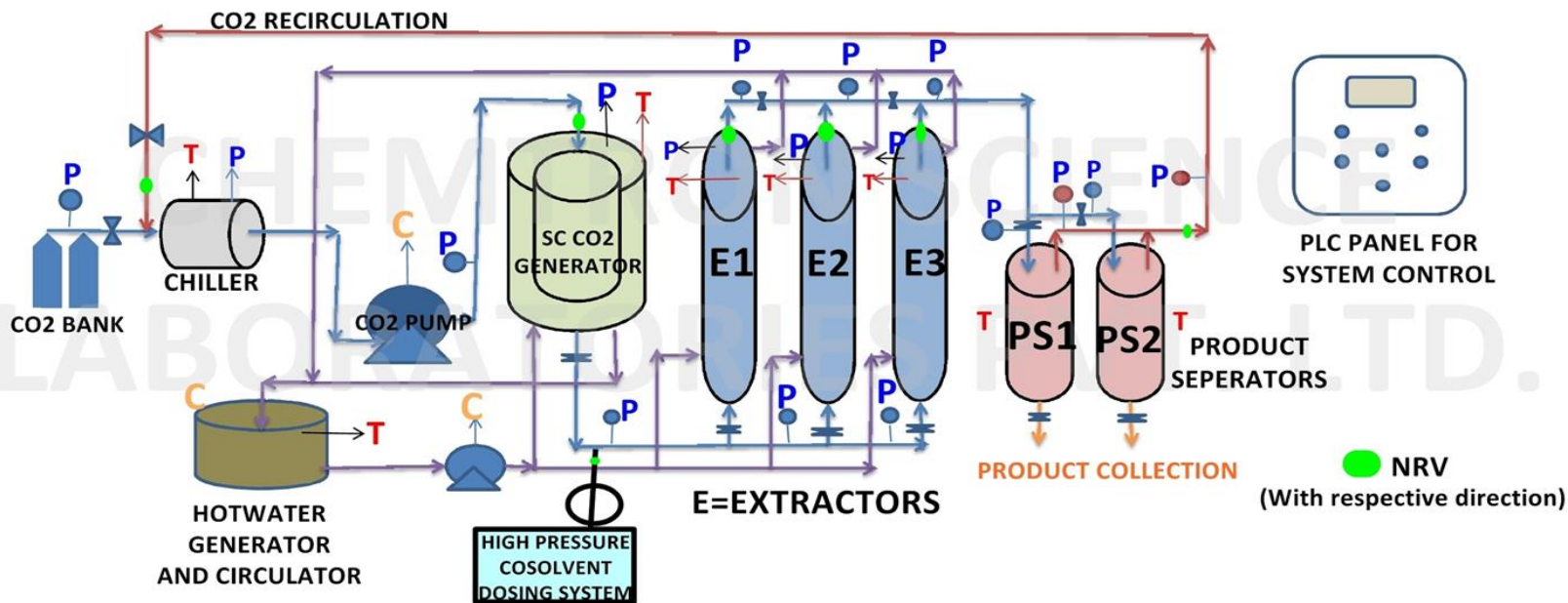
- 1) Rosemary and Lavender is extracted at temperatures of 40 deg C and pressures of 100 bars.
- 2) Cumin Oil is extracted from cumin seeds at temperatures of 50 deg c and pressures of 200 bars.
- 3) Ginger and Turmeric: Oils are extracted by keeping temperatures of 50 deg C and pressures of 300-350 bars.

# Parts Of Supercritical CO<sub>2</sub> Extraction System

- 1) CO<sub>2</sub> Source
- 2) Chiller for CO<sub>2</sub> Liquification as well as storage
- 3) Liquid CO<sub>2</sub> Pump
- 4) SCF Generator
- 5) Extractor Vessel(s) •
- 6) Separator Vessel(s)
- 7) Regulators

# SCFE Process

## SUPERCritical CO<sub>2</sub> EXTRACTION SYSTEM 20LX3 EXTRACTORS WITH 3LX2 PRODUCT SEPERATORS



FLOW CHART ONLY FOR UNDERSTANDING THE PROCESS  
NOT AS PER PRODUCTION SCALE

**CHEMTRON SCIENCE LABORATORIES PVT. LTD.**



# 1 Liter SCFE System



# 30 Liter SCFE System



# Salient Features Of Chemtron SCCO<sub>2</sub> Extraction System

- 1) Cost Effective – Less than 1/3<sup>rd</sup> cost of other counterparts
- 2) Multiple Extraction Vessels- Choice of single to multiple extractors
- 3) Proprietary CO<sub>2</sub> Pump Head- Pressures that can be achieved are 600 bars
- 4) Availability of Certified Systems- Certified product
- 5) On site with PLC Control and as well as remote monitoring of parameters with SCADA- Easy operations
- 6) Accurate temperature control- State of the art electronic sensors
- 7) Accurate pressure control- State of the art electronic sensors
- 8) Customizable parameters- System is customized as per need
- 9) All high pressure vessels and tubings hydro tested at design pressures
- 10) Recycling as well as storage through chiller for liquid CO<sub>2</sub> after the extraction.- Chiller as storage, recycling & recovery of CO<sub>2</sub>
- 11) Three stage safety feature for the system both for temperature and pressure

## Features continued.....

- 12) Advantage to extract polar as well as non polar components
- 13) No interference or presence of pesticides in extracted samples
- 14) Operations can be handled by only one skilled person with one assistant



## Percentage Extracted

Vetevir ( Khas) 3%-4%

Ginger oil 6.5%-9.5%

Sandalwood oil 4%-9%

Flaxseed Oil 1%-3%

Rosemary Oil 2-4%

Lavender Oil 2-5%

Ginger Oil 6-10%

Cumin Seed Oil 8-10%

Clove bud oil 10%-20%

Commiphora Myrrha 4%

Sasurea radix ( root) 3%

Jatamansi Valerina 3%



Turmeric oil 6%-9.5%

Curcumin from turmeric 2%-5%

Marigold 2%

# Reviewing





# Role of Chemtron for SCFE

CSL is the only company who has successfully manufactured SCFE system Indigenously in India

CSL for the past 15 years have been dedicatedly doing R&D on SCFE systems and have sold more than six such units pan India and the seventh is in its dispatch stage. SCFE machine is indigenously manufactured in India.



We have a good data and experience in extraction of various materials in supercritical co<sub>2</sub> extraction system. Being a manufacturing company we have an advantage over providing life time services which many of the counterparts are lacking.



**CSL had manufactured this system ten years earlier for extraction of some chelate compounds from soil. But we found out that the system has lot many more useful applications and we started manufacturing it commercially. We have successfully installed 7 units in various parts of India and the eighth one is due for dispatch. We also have a few good orders in the pipeline.**

**CSL was established in 1992<sup>●</sup> mainly for manufacturing calibration gases. In due course of time we have formed four verticals 1) Gases 2) Electronics 3) Engineering & 4) Post Harvest Technologies. We have an R&D department which compliments all the research and development in the above mentioned verticals. CSL has a steady growth of 25% per year.**





CSL is having a steady growth of 25% per Year. We are having an employ strength of 180 who are dedicated towards the growth of the company. We have more than 150 products in our manufacturing line and have more than 20000 installations pan India and Abroad. Having an experience of more than 24 years we have an edge over our counterpart. Our service team has always provided timely solutions to our clients.

The machine is manufactured completely in India under Make In India scheme and we request you to give us an opportunity to manufacture this machine for you in India.

# OUR OFFER TO YOU

To start with as business partners we offer you the following

- Partner with us for extraction services:

- We will extract raw materials for you.



# CONTACT DETAILS

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# Supercritical Co2 Extraction System



## Advantages of Supercritical CO2 Extraction over conventional:

### Solvent Extraction

- Solvent Presence Is Unavoidable. The Residual Ppm Level Of The Solvent Depends On The Type Of Solvent Used.
- Heavy Metal Content Is Also Unavoidable And Depends On The Solvent, The Recycle Method For The Solvent, The Source Of The Raw Material, And The Material Of Construction Of The Contact Parts Of The Machinery
- Inorganic Salt Content Cannot Be Avoided, Using The Same Concept As Above
- Polar Substances Get Dissolved Along With The Lipophilic Substances From The Raw Material Due To Poor Selectivity Of The Solvent. During Solvent Removal Operation, These Polar Substances Form Polymers, Which Lead To Dark Color Of Extract And Poor Flow Characteristics. All This Renders The Extract To Look Different From The Basic Components In The Raw Material And Hence It Is More Of A "Pseudo" Natural Extract.
- Both Polar As Well As Non Polar Colors Are Extracted
- Solvent Removal Requires Extra Unit Operations And Hence The Cost And Recovery Of Useful Material Is Lower
- Not hygienic as protein molecules also get dissolved

### SCF Extraction

- Only CO2 is used as solvent which after extraction is released and recycled hence no residual and hence Totally Free Of Solvents And product Very Pure
- Totally Free Of Heavy Metals Since They Are Not Extractable Even If They Are Present In The Raw Material. No Heavy Metals Are Present In CO2 And The Equipment
- Totally Free Of Inorganic Salts Using The Same Explanation As Above
- Totally Free Of Inorganic Salts Using The Same Explanation As Above No Such Possibility Since There Is Very High Selectivity Of CO2 And No Chance Of Polar Substances Forming Polymers. In Addition The Operating Temperature Is Only 40-50 Degree Celsius.
- Choice of polar and Non-Polar components Available for Extraction.
- No Extra Unit Operations Needed And Yield Of Useful Material Is Very High
- No question of biological contaminant.

### List of few extracts from our pilot plant:

Clove bud oil	19%-20%	Commiphora Myrrha	4%
Sasurea radix ( root)	3%	Jatamansi Valerina	3%
Turmeric oil	6%-9.5%	Curcumin from turmeric	2%-5%
Marigold	2%	Vetevir ( Khas)	3%-4%
Ginger oil	6.5%-9.5%	Sandal wood oil	4%-9%
Flaxseed Oil	1%-3%		



## Scope, Specification and Supply of the Supercritical CO<sub>2</sub> Science Laborato

### 1. Extraction Vessels (Extractor):

**Capacity:** V  
**No. In the system:** X  
**Design Pressure:** 700 Bar **Operating Pressure:** 413 bars **Design Temperature:** 100° C.  
**Material of Construction:** Stainless Steel 316  
**Vessel Configuration:** Vertical.  
**Ends:** Quick closure system with pressure interlocks. **Sealing:** Variseal, PTFE.  
**Safety Features:** Safety valve, Stainless Steel porous filters to be provided at the inlet and outlet of the extractor to prevent carry over of the time particles of the material to be extracted.

### 2. High Pressure Product Separator:

**Capacity:** U Liter. (MOC SS 316)  
**No. In the System:** Q  
**Design Pressure:** 413 bars. **Operating Pressure:** 350 bars.  
**Design Temperature:** 100 C.  
**Pressure Control:** through micrometer needle valve/BPR

### 3. Liquid CO<sub>2</sub> Pump:

**Type:** reciprocating plunger.  
**No. In the system:** 1  
**Maximum Operating Pressure:** 413 bars  
**Discharge Capacity:** Variable. (30 LTR /HR ) 500ml/min  
**Drive:** Mechanical  
**Material of construction:** pump head – Stainless Steel, Plunger/ Diaphragm - sapphire / Stainless Steel. Seals- PTFE.  
**A.** The pump is provided with Safety Relieve Valve and Pressure Switch (Auto cut-off in set pressure ) pressure gauge, overpressure protection (Safety Relieve valve ).  
**B.** The pump controller has built in feature for reading out the flow rate of the CO<sub>2</sub> being pumped

### 4. Control Panel Details:

**Type:** PLC controller  
**Pressure Indicator:** All Digital and analogue for pressure zones  
**Temperature Indicator:** All Digital for heating and cooling zones  
**Pump Flow Control:** Thru System software

### 5. Heating & Cooling Arrangement

**For gentle heating & precision temp. Control.**  
**A.** HOT WATER GENERATOR. WITH HOT WATER CIRCULATOR  
**B.** REFRIGERATION UNIT WITH CHILLED WATER CIRCULATOR

### 6. Piping & Valves:

The entire piping to be made in Stainless Steel seamless pipes with welded joints and quick connectors of the type of SWAGELOCK. The individual equipment to be provided with needle valves for isolation, safety valves and rupture discs. For protection etc. all the piping and valves are to be rated for 1200 bars pressure.  
**A.** High Pressure Safety Relieve Valve 3 Nos.  
**B.** High Pressure Regulator 3 Nos.  
**C.** High Pressure Non Return Valve 1 Nos.

### 7. Process Parameter Indicators/ Control:

**A.** Pressure Indicator (Digital gauge 2 Nos.)  
**B.** Temperature Indicator –20 to 100 Deg. C.  
**C.** Digital Temperature Controller 1 No's.  
 The control panel is the heart of system operation and control. The panel shall house the necessary safety interlock switches, PID temperature control and indicators as well as alarm annunciation. The control system shall be suitable for automatic operation with manual override and indication/ alarm annunciation.

### 8. Feed Carbon Dioxide

The System will be offered complete with 2 nos. CO<sub>2</sub> Cylinder filled 30 kg x 2 (60kg ) CO<sub>2</sub> with Manifold

### 9. Spare Parts

**A.** Accessories For Pump: O, Ring – 4 Nos.  
**B.** Extraction Vessel Gas Kit – 2 Nos.  
**C.** High Pressure Regulator 1 Nos.  
**D.** Valves 2 Nos..

### VARIABLES

V= Extraction Vessel Capacity Required  
 X= Number of Extraction Vessels.  
 U= Product Separator Capacity  
 Q= Number of Product Separators  
 T= Temperature of Sample P= Pressure Required for Sample  
 Whether Single Pass or CO<sub>2</sub> Recirculation is Required

### 10. OPTIONAL

**Extra, not included in the main system)**  
**A. CONSOLVENT / ENTRAINER SOLVENT PUMP:** Type: reciprocating plunger.  
**No: in the system:** 1.  
**Maximum Operating Pressure:** 400 bars (Pressure range 0-100 bars)  
**Discharge capacity:** Variable, 0-5 lits of organic solvent (like Ethanol)  
**Drive:** Mechanical with VFD.  
**Material of Construction:** Pump head – Stainless Steel.  
 Diaphragm - Stainless Steel. Seals – PTFE.  
**B. Additional FEED CARBON DIOXIDE** (2 nos. CO<sub>2</sub> Cylinder filled 30 kg x 2 (60kg) CO<sub>2</sub>) with Manifold.

SYSTEMS AVAILABLE FROM 1LITER TO 150 LITER CAPACITIES

Visit Our Factory for More Details

**CSL** Chemtron Science Laboratories Pvt. Ltd.

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## Chemtron Science Laboratories Pvt. Ltd.

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### CHEMTRON PROFILE

#### WE DELIVER GREEN TECHNOLOGY OF THE FUTURE

**We Chemtron Science Laboratories Pvt. Ltd. as a company give state of the art technology to manufacture the equipments on turnkey basis.**

**We are an ISO 9001: 2008 by BSI**, a part of fastest growing industry i.e. chemical and Electronics Industry, established in the year 1992, since then CSL has 25% growth rate annually. CSL has well equipped high technology lab equipments, testing and inspecting facilities, which makes its products one of the best in the industry. CSL has a team of trained qualified engineers in its R & D Department, which constantly seeks to innovate, specialized products as per customer's requirement.

The company was formed by Dr. O P Srivastava who is a retired Senior Scientist from BARC. Chemtron Science Laboratories Has made one setup of ripening of fruits at Barabanki. Barabanki is the birth place of Dr. O. P. Srivastava. He was born on 15<sup>th</sup> Dec 1940 at Barabanki and studied up to intermediate up to 1958 He joined 7<sup>th</sup> batch of Training School at BARC in 1964. He has done his PHD from University of Wales, UK.

Dr. O. P. Srivastava was the first person to in India to provide ethylene gas for ripening purpose. This was introduced in early 1995 by giving ripeners the ripening gas cylinders. Our first customers were Mother Dairy plant at Goregaon. Today this technology has spread all over India and CSL Pvt. Ltd. is supplying gases to more than thousands of customers.

Dr. O. P. Srivastava dreamed of opening a ripening facility at Barabanki to bring this technology to the place where he was born.

Dr. O. P. Srivastava is presently running his own company "Chemtron Science Laboratories Pvt. Ltd. "for the past 27 years.

The company today has grown five major verticals 1) Gas 2) Engineering 3) Electronics 4) Post Harvest Technology & 5) R&D .

#### TEAM CHEMTRON

Consisting of well trained qualified Chemists with education qualification of B.Sc., M.Sc. and have more than 9-10 years experienced Engineers and Senior Quality Control Inspectors. Apart from that we also have assistance from various consultants. The Chairman of the company Dr. O.P. Srivastava has been awarded PhD. Degree from University of Wales-U.K. in the field of Gas Chromatography, has been associated for more than 30 years in developing G.C.'s, Process Control Instruments, etc. As a retired BARC scientist, his expertise and experience adds value to our organization. Our Technical Director Shri Ashish Srivastava executes turnkey projects and stream line the manufacturing process in our industry.



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### Maintenance & Service Division

We have our own Service and Maintenance team for all of our products listed and manufactured by us. Being a 22 Year old company we have established good contacts all over India and have branches located at strategic points all over the country.

### Sales Network

To cater specific needs of our customers who are scattered in all parts of India, CSL has developed an efficient well connected marketing team consisting of Dealers operating in all four corners of India. Being a manufacturer of specialised products, most of the marketing takes place through direct, personal and customer's word of mouth. However CSL also participates and advertise regularly in various Fairs and Exhibitions and have given write-ups in various Journals related to Analytical Instruments Field.

### Technical

1. Complete in-depth technical knowledge of working & manufacturing GC's, Gas Analysers in terms of Electronics and Analytical capability. We also have projects division which deals with sampling bombs, sampling systems, calibration gases and standard calibration blends.
2. Trained Chemists, in house availability of Std. Gas Mixtures and well-equipped Analytical Lab, enables to fulfill all calibration standardization needs of the instruments.
3. We have Qualified Engineers already experienced in installation, repair and maintenance of Instruments.



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### Commercial

1. Well established contacts in industry in the field of instrumentation over the past 27 years.
2. Good infrastructure with latest communication facilities.
3. Registered with various consultants, projects and system houses, in most of the government/non government institutions in all over India.

### Our Moto

We are pledged to provide Industries and people, technology that is green and cost effective as compared to our counterparts.

## CHEMTRON Facility & Services

Chemtron Science Laboratories has a research team of experienced and dedicated industrial professionals Led by Dr. O.P. Srivastava & Mr. Ashish Srivastava. Our research department is with well equipped facilities with most advanced lab equipments & a library for literature references.

### 1-Our Turn Key Projects

Our capabilities lie in executing Turn Key projects for building pilot plants, laboratory piping's, lab gas distribution systems and various types of sampling systems.

### 2-Supercritical Extraction System

With in-house designed & fabricated manual / semi automatic / Fully automatic PLC controlled Supercritical fluid extraction system, of various capacities starting from 100 ml to 50 lit; We have successfully extracted Clove buds, Turmeric, Ginger, Garlic, Rice Bran , Rice Bran Wax, Sandalwood, etc and many more of unknown samples not listed. The system is capable of supercritical CO<sub>2</sub> extraction of many other products for Pharmaceutical Industries & Flavours & Fragrances industries. We also provide Analytical support for analysis of various Extracts / Absolutes extracted from supercritical fluid extraction.

### 3-Gas Chromatographs

We are specialized in customized Gas Chromatographs. The instruments are equipped with speciality detectors like TCD, FID, FPD, PID, HID for detection & analysis of Trace level impurities.





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Typical applications of Chemtron make GCs include in Industries Like Petroleum, Petrochemicals, Oil & Gas Industries, Fertilizers, Power plants, Automobiles, Environment & Chemical Industries. We also make GC for special applications like Transformer Oil Analysis, Natural Gas, and LPG analysis.

We also provide Analytical support for analytical method development & chromatographic analysis of various Gases & Chemicals etc.

### 4-Gas analyser

We manufacture highly sensitive & accurate gas analyzers working on principles of Electrochemical & Infra Red. We are specialized in gas analyzers for the detection of CO, CO<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, Hydrocarbons, CH<sub>4</sub>, NO, NO<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, Cl<sub>2</sub>, NH<sub>3</sub> etc. Our gas analyzers have capacity range from PPM to % level. Our gas analyzers are calibrated using high accuracy NIST / NPL traceable gas standards.

We also provide Calibration support for all types of gas analysers.

### 5-Online gas detectors

We manufacture online gas detectors customized for real time online gas detection / analysis. Typical applications of Chemtron make GCs include Petroleum, Petrochemicals, Oil & Gas Industries, Fertilizers, Power plants, Automobiles, Environment & Chemical Industries.

### 6-Control Atmosphere systems for cold storage :

We manufacture & supply Controlled atmosphere system for cold storage. In CA system, we control Oxygen content, CO<sub>2</sub> content, Ethylene content in the cold storage chamber. The whole system is fully PLC controlled Single chamber / Multi chamber Up to 16 chambers. We can set different control parameters for different commodities the prolonged storage of different commodities. The systems include Nitrogen generation plant, Ethylene scrubber & CO<sub>2</sub> scrubber.

We also supply R&D support for CA storage conditions for various commodities like Lemon, Apple, Peach, Custard apple, & many more.

### 7-MAP-Modified Atmospheric packaging

We also provide Technologies in Modified Atmospheric packaging for various commodities. We also supply R&D support for MAP packing conditions for various commodities like Garlic, onion Lemon, Apple, Peach, Custard apple, & many more.



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### 8-Ripening

We manufacture & supply Ripening Chamber & manual/semiautomatic & fully Automatic ripening system and fully PLC controlled Single chamber / Multi chambers. We can set different control parameters for different commodities fast & natural Ripening.

We also supply R&D support for ripening conditions for various commodities like Banana, Mango, Lemon, Apple, & many more.

### 9-Vapour phase catalytic Reactions

We are specialized in Vapor phase catalytic reactions. We supply vapor phase catalytic reaction technologies for

1. Vapour-phase Catalytic Dehydration of Ethyl alcohol to form Ethylene gas.
2. Vapour-phase Catalytic Dehydration of Propyl Alcohol to form Propylene gas.
3. Vapour-phase Catalytic Dehydration of butyl alcohol to form butylene gas.

We also undertake Research activities for various vapour phase catalytic reactions from lab to plant scale. These include Catalytic methylation, Amination, dehydration reactions etc.

We also supply Lab scale vapour phase catalytic reactions systems for reaction study, catalyst performance.

### 10- Nitrogen Generation Plant

We manufacture the PSA base & membrane base nitrogen generation plant of various capacities.

### 11-Steam distillation

We also expertise in the Steam distillation & recovery of valuable herbs .

We also provide Analytical support for analysis of various Extracts / Absolutes extracted from Steam distillation extraction.

### 12-Calibration Gas mixture

We are the leader in the manufacture of Calibration gas mixture; we can prepare all types of calibration gases mixture which used in Petrochemical, Chemical, Environmental, Automobile, Hospitals, Oil & Gas Industries, Fertilizers, Power plants and many more industries.



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We also provide technical support to Analyze any gas & calibrate any instrument.

### **13- H<sub>2</sub>S Scrubbing**

We provide portable H<sub>2</sub>S Scrubbing System for H<sub>2</sub>S scrubbing from Biogas.

### **14-Brazing &Cutting gas**

We manufacture the Cutting & brazing mixture from the temperature 1000 °C to 3500 °C. We also provide technical support to resolve any kind of Brazing & cutting issue.

### **15- Ethylene Manufacturing Plant**

We have a state of the art Ethylene Manufacturing Plant to serve the needs of our customers who use ethylene for ripening of fruits. The capacity of manufacturing is 15Kg/hour.

## **QC lab**

We have well equipped laboratory & highly Qualified staff to do various types of Analysis. We do the following type of analysis at our end & give The NIST/NPL traceable certified reports.

### **1-Biogas Analysis**

We do the Methane, CO<sub>2</sub>, Nitrogen, Oxygen & H<sub>2</sub>S content in Biogas Sample.

We also provide technical Help in Sampling of Biogas.

### **2-NG analysis**

We do the Methane,CO<sub>2</sub>, Nitrogen, Ethane, Propane. Butanes, Pentanes, Hexane & C+ content in Natural gas Sample. We also analyses Calorific Value & specific Gravity of Natural Gas Sample.

We also provide technical Help in Sampling of Natural gas



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### **3-LPG analysis**

We do the Methane, Ethane, Propane. Butanes, Pentanes, content in LPG gas Sample. We also analyses Calorific Value & specific Gravity of LPG Gas Sample.

We also provide technical Help in Sampling of LPG gas

### **4-AMBIENT AIR POLLUTION**

We Analyse the Ambient Air for the air pollutants like CO, CO<sub>2</sub>, NO, NO<sub>2</sub>, SO<sub>2</sub> etc gases

We also provide technical Help in Sampling of polluted air.

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**And**

**[www.chemtronlabs.com](http://www.chemtronlabs.com)**

**And**

**[www.ripeningsolutions.com](http://www.ripeningsolutions.com)**

**FOR FURTHER DETAILS.**

# CHEMTRON SCIENCE LABORATORIES PVT LTD

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## EXPERIMENT DATA:

### ➤ EXPERIMENT No1.

- Object : To get Extraction of Clove Bud
- Raw Material : Clove Bud
- Data in table form:

Cycle Number	Cooling & Heating Time	Recycle Time	Qty of Clove Bud	1 <sup>st</sup> Bottle		2 <sup>nd</sup> Bottle		3 <sup>rd</sup> Bottle	
				Temp	Pressure	Temp	Pressure	Temp	Pressure
	(Min.)	(Min.)	(gram)	(Deg C)	(Bar)	(Deg C)	(Bar)	(Deg C)	(Bar)
1st	60	45	474	40-60	170-190	40-60	170-190	30-40	20-40
2nd	60	60	474	40-60	170-230	40-60	170-230	30-40	30-50
3 <sup>rd</sup>			474	40-60	170-190	40-60	170-190	30-40	20-40

**RESULT:**

1. Time for 1<sup>st</sup> Collection: 45 Min.
2. Time for 2<sup>nd</sup> Collection: 45 Min
3. Time for 3<sup>rd</sup> Collection: 45 Min
4. Yield: More Than 18.23% White , Yellow & Brown Essential Oil , 86.61 gram.
5. Flow Rate for separation :
6. Size Of Particle ( Clove Bud ) : Powder
7. Total Time : 390 Min.

➤ **EXPERIMENT No 2.**

- **Object :** To get Extraction of Commi Phora Myrrha
- **Raw Material :** Commi Phora Myrrha
- **Data in table form:**

Cycle Number	Cooling & Heating Time	Recycle Time	Qty of Clove Bud	1 <sup>st</sup> Bottle		2 <sup>nd</sup> Bottle		3 <sup>rd</sup> Bottle	
	(Min.)	(Min.)	(gram)	Temp (Deg C)	Pressure (Bar)	Temp (Deg C)	Pressure (Bar)	Temp (Deg C)	Pressure (Bar)
1st	60	45	510	45-60	120-130	40-60	170-190	10-30	20
2nd	60	60	510	45-60	170-130	40-60	170-190	10-30	20
3rd	60	90	510	45-60	170-150	40-60	170-230	10-30	20

**RESULT:**

1. Time for 1<sup>st</sup> Collection: 45 Min.
2. Time for 2<sup>nd</sup> Collection: 45 Min
3. Time for 3<sup>rd</sup> Collection: 45 Min
4. Yield: More Than 1.9 % Dark Brown Like Volatile Oil , 9.8 gram. Approx ..
5. Flow Rate for separation :
6. Size Of Particle ( Clove Bud ) : 5mm
7. Total Time : 390 Min.

➤ **EXPERIMENT No 3.**

- **Object :** To get Extraction SASUREA RADIX (ROOT)
- **Raw Material :** SASUREA RADIX (ROOT)
- **Data in table form:**

Cycle Number	Cooling & Heating Time	Recycle Time	Qty of Clove Bud	1 <sup>st</sup> Bottle		2 <sup>nd</sup> Bottle		3 <sup>rd</sup> Bottle	
	(Min.)	(Min.)	(gram)	Temp (Deg C)	Pressure (Bar)	Temp (Deg C)	Pressure (Bar)	Temp (Deg C)	Pressure (Bar)
1st	60	45	400	39	78-80	31	60-70	40	30
2nd	60	60	400	39	78-80	31	60-70	40	30
3rd	60	90	400	39	170-230	32	120-130	40	30

**RESULT:**

1. Time for 1<sup>st</sup> Collection: 45 Min.
2. Time for 2<sup>nd</sup> Collection: 45 Min
3. Time for 3<sup>rd</sup> Collection: 45 Min
4. Yield: More Than 1 % Dark Brown 5.67 gram Like Honey (Oil). Target Yield 24 Gram (6 %)
5. Flow Rate for separation :
6. Size Of Particle ( Clove Bud ) : Powder
7. Total Time : 510 Min
8. Total Extract : 13.82 Gram (14 gram ) More then 3.5 %

➤ **EXPERIMENT No 4.**

- **Object :** To get Extraction of JATAMANSI VALERIANA
- **Raw Material :** JATAMANSI VALERIANA
- **Data in table form:**

Cycle Number	Cooling & Heating Time	Recycle Time	Qty of Clove Bud	1 <sup>st</sup> Bottle		2 <sup>nd</sup> Bottle		3 <sup>rd</sup> Bottle	
				Temp	Pressure	Temp	Pressure	Temp	Pressure
	(Min.)	(Min.)	(gram)	(Deg C)	(Bar)	(Deg C)	(Bar)	(Deg C)	(Bar)
1st	60	45	400	39	100-120	31	80-100	40	30
2nd	60	60	400	39	100-120	31	80-100	40	30
3rd	60	90	400	39	150-160	32	100-110	40	30

**RESULT:**

1. Time for 1<sup>st</sup> Collection: 45 Min.
2. Time for 2<sup>nd</sup> Collection: 45 Min
3. Time for 3<sup>rd</sup> Collection: 45 Min
4. Yield: Yield : More Then 2 % Light Brown 7.05 gram Like Oil .
5. Flow Rate for separation :
6. Size Of Particle ( Clove Bud ) : Powder
7. Total Time : 510 Min
8. Total Extract : 12.55 Gram More then 3.5 %



## **FEATURES OF CHEMTRON SC CO2 EXTRACTION SYSTEM**

Chemtron SC CO2 systems are developed for Indian Environments. They are cost effective and economical in operations. A well trained worker can easily operate the system and get the extracts.

SC CO2 Systems are made from SS316 material. Operational pressures up to 400 Bars. Temperatures ranges from 40°C to 80°C for water heated systems and 40°C to 200°C for coil heated systems.

### **Details:**

- 1) Type of Extractor – From Solid Liquid extractor.
- 2) Extractor Sizes – 5 Liter to 100Liters.
- 3) Design Material – SS316.
- 4) Seperator Sizes – 1Liter to 20Liter.
- 5) Pressure Range – 70 Bars to 400 Bars.
- 6) Temperature range - 40°C to 80°C.
- 7) Carbon Dioxide Source – Liquid CO2 Cylinder
- 8) Control panel – Single TFT Screen with soft switches for setting the parameters.
- 9) Accessories – Complete set of accessories with the system for uninterrupted operations.
- 10) Learning Material: A complete set of operation manuals along with safety tips to fast trouble shoot operations.

### **Components of SC CO2 System:**

- 1) Liquid CO2 Gas Cylinder.
- 2) Chiller.
- 3) High Pressure CO2 Pump
- 4) High Pressure SC CO2 Generator.
- 5) High Pressure Extractor.
- 6) High Pressure Product Seperator.
- 7) High pressure Solvent introduction unit.
- 8) Automated PLC System.
- 9) Pressure Sensors, Regulators, Temperature Sensors, NRVs, SRVs and Pressure Gauges.

### **Training on SC CO2 System:**

Chemtron provides complete training and trials of samples on the machine in front of the technical personnel of the company who has purchased the system. Before dispatch a certificate will be given to the customer when the trial runs on his purchased system are confirmed and the results concluded with the signatures of our factory manager and the inspection authorized signatory from the purchaser. The system will be modular and will be a single unit that eases transportation and installation.

Right Protected: Chemtron Science Laboratories Pvt. Ltd.

Contact : [sales@chemtron.net.in](mailto:sales@chemtron.net.in)  
Website: [www.chemtronscience.com](http://www.chemtronscience.com)

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## WHY SC CO2 EXTRACTION IS BETTER

- Supercritical fluids (SCFs) are increasingly replacing the organic solvents that are used in industrial purification and recrystallization operations because of regulatory and environmental pressures on hydrocarbon and ozone-depleting emissions.
- A supercritical fluid is characterized by physical and thermal properties that are between those of the pure liquid and gas. The fluid density is a strong function of the temperature and pressure. The diffusivity of SF is much higher than for a liquid and readily penetrates porous and fibrous solids. Consequently, can offer good catalytic activity.
- The main advantages of using supercritical fluids for extractions is that they are inexpensive, extract the analytes faster and more environmentally friendly than organic solvents. For these reasons supercritical fluid CO<sub>2</sub> is the reagent widely used as the supercritical solvent.
- The relatively low temperature of the process and the stability of CO<sub>2</sub> also allows most compounds to be extracted with little damage or denaturing.
- With the SFE procedure, the separation and fractionation is carried out in a continuous counter-current operation. The SFE process offers a new alternative to the conventional methods, eliminating both the thermal degradation of the active ingredients caused by high processing temperatures and high operating costs.
- Advantages utilizing supercritical fluid extraction are
  - Better shelf life due to co-extraction of antioxidants and elimination of dissolved oxygen
  - No residual toxic solvents and much – reduced pesticides
  - No thermal degradation
  - Continuous process
  - Low operation cost
  - Environmentally compatible
  - Rapid diffusion of CO<sub>2</sub> through condensed phases
  - SCFs have solvating powers similar to liquid organic solvents, but with
    - higher diffusivities,
    - lower viscosity, and
    - lower surface tension.

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- Since the solvating power can be adjusted by hanging the pressure or temperature separation of analytes from solvent is fast and easy.
- By adding modifiers to a SCF (like methanol to CO<sub>2</sub>) its polarity can be changed for having more selective separation power.
- A comparative study has been carried out between various extraction methods and salient points are summarized below:

### Comparison with other extraction techniques

No.	Solvent extraction	Supercritical Fluid Extraction
1	Solvent presence is unavoidable. The residual ppm level of the solvent depends on the type of solvent used.	Is totally free of solvents and hence very pure
2	Heavy metal content is also unavoidable and depends on the solvent, the recycle method for the solvent, the source of the raw material, and the material of construction of the contact parts of the machinery.	Totally free of heavy metals since they are not extractable even if they are present in the raw material. No heavy metals are present in CO <sub>2</sub> and the equipment
3	Inorganic salt content cannot be avoided, using the same concept as above	Totally free of inorganic salts using the same explanation as above
4	Polar substances get dissolved along with the lipophilic substances from the raw material due to poor selectivity of the solvent. During solvent removal operation, these polar substances form polymers, which lead to dark color of extract and poor flow characteristics. All this renders the extract to look different from the basic components in the raw material and hence it is more of a "pseudo" natural extract.	No such possibility since there is very high selectivity of CO <sub>2</sub> and no chance of polar substances forming polymers. In addition the operating temperature is only 40-50 degree Celsius.
5	Both polar as well as non polar colors are extracted	Only non polar colors get extracted
6	Solvent removal requires extra unit operations and hence the cost and recovery of useful material is lower	No extra unit operations needed and yield of useful material is very high

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- Therefore the “Supercritical CO<sub>2</sub> Fluid Extraction method” is much superior than the available conventional Steam Distillation and Solvent extraction method and has vast potential commercially in India.
- This technology is being used extensively in extracting strategic material such as plutonium and other heavy metals and based on this technology complete system has been imported by BARC and IGCAR.

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### **Applications of SFE Extraction Technology:**

- **It includes**

- Extraction of herbal medicines
- Extraction of Spice aroma or flavor (essential oil/ essence) of Red Chili, Paprika, Ginger, Nutmeg, Black pepper Vanilla, cardamom, Fennel, areaway, Coriander, Garlic, Cinnamon, etc.
- Decaffeination of coffee and tea
- Deodorization of oils and fats
- Extraction of vegetables oils from flaked seeds and grains
- Flavors, fragrances, aroma and perfumes
- Hops extraction for bitter
- Stabilization of fruit juices
- Lanolin from wool
- Decoiling of fast foods
- Decholesterolization of egg yolk and animal tissues
- Antioxidants from plant botanicals
- Natural pesticides
- Denicotinization of tobacco
- Extraction of vitamin E from soybean oil
- Soil remediation and activated carbon regeneration.
- For removal of organics from contaminated soil.
- Extraction of inorganic species
- recovery of organics from oil shale, separations of biological fluids,
- bioseparation,

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- selective extraction of fragrances,
- oils and impurities from agricultural and food products.
- Supercritical Fluid Extraction technology (SFE) based on CO<sub>2</sub> as fluid is widely used in food and spices extraction, Pharmaceutical, Naturopathy and environmental industries.

- **Food applications :**

Carbon dioxide is the most common supercritical fluid in the food industry. Due to the non-toxicity and low critical temperature, it can be used to extract thermally labile food components and the product is not contaminated with residual solvent. Further, the extract's color, composition, odor, texture are controllable and extraction by supercritical fluid carbon dioxide retains the aroma of the product. Supercritical carbon dioxide extraction is used as a replacement for hexane in extracting soybean-oil and has been tested for extraction from corn, sunflower and peanuts. Supercritical fluid extraction provides a distinct advantage not only in the replacement but also extracts oils that are lower in iron and free fatty acid. To satisfy the consumer's need for 'lighter' foods, developmental work on supercritical extraction of oils from potato chips and other snack foods are being carried out. In addition, supercritical carbon dioxide has also been used to extract lilac, essential oils, black pepper, nutmeg, vanilla, basil, ginger, chamomile, and cholesterol.

- **Pharmaceutical applications:**

Since the residual solvent present in the extracted material is of critical importance in the pharmaceutical industry, supercritical fluid carbon dioxide has found several applications. The extraction of vitamin E from soybean oil and a purification method for vitamin E has been well studied. The latter process avoids the step of vacuum distillation, which usually results in the thermal degradation of the product. Solubilities and recrystallization of various drugs has been demonstrated in supercritical fluids.

- **Application in Naturopathy:**

Nutrition plays a vital role in strengthening the body's immune system. These nutrients ought to be close to their original form so that they create the least disturbances in body systems. Consequently it is preferred that they be derived from natural source, in the form of natural extracts. But

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while extraction with help of conventional extraction methods, compelling regulations on the usage of hazardous, carcinogenic or toxic solvents have curtailed the growth of natural extract industries. However now SFE **Extraction Technology by CO<sub>2</sub>** has emerged as the alternative to the traditional solvent extraction of natural products. It uses CO<sub>2</sub> gas as solvent, which is clean, safe, inexpensive, nonflammable, nontoxic, environment-friendly, and nonpolluting solvent.

- **Environmental applications:**

Due to strict environmental regulations, supercritical fluids are used as replacements for conventional hazardous chemicals such as hexane. Supercritical fluid extraction has been proposed as an alternative technique for soil remediation and activated carbon regeneration. Over 99% of a majority of organics can be removed from contaminated soil. Organics that have been successfully extracted include PAHs, PCBs, DDT and toxophene. Carbon dioxide has been used with entrainers for the extraction of highly polar compounds. A commercial process to separate oils from refinery sludge and contaminated soil has been developed by CF Systems Corporation, USA. Chelating moieties that dissolve into carbon dioxide have been developed for the extraction of heavy metals from soil.

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### **USE OF SCFE SYSTEM IN INDIA**

- In India verity of herbs, spices and other rare medicine plants are available in ample quantity whose extract is quite valuable and useful in all walks of life.
- However till date the Extraction of these valuable herbs, spices etc is being done with help of conventional methods only.
- For getting extraction with help of Supercritical CO<sub>2</sub> fluid extraction methods still we are depending on imported technology, plant & machinery.
- This imported technology, Plant & machinery is very costly and due to lack of indigenous maintenance infrastructure, no proper maintenance support is also available in India.
- Since the field of “ Extraction of various type of herbs and other valuable spices” has vast potential from commercial, as well as medicine and research point of view, we have not only developed the technology of Supercritical CO<sub>2</sub> fluid extraction but also have developed the method of analysis the active ingredients of these extract indigenously.
- Due to indigenous technology the cost of this extraction method will drastically reduced to 1/3 of present cost and also full maintenance support will be available at very reasonable rates to Indian firms, scientist and other users.
- Therefore the plenty of valuable, rare and costly herbs and spices which are available in ample quantity as vast raw material can be converted into finished product by adding value with help of the technology developed by us indigenously and same can be analyzed and characterized by GC and HPLC instruments with help of the method developed by us indigenously.



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### **PRESENT STATUS OF SC CO2 EXTRACTION PROJECT IN CSL**

- SCF technology requires sensitive process control, which is a challenge. In addition, the phase transitions of the mixture of solutes and solvents has to be measured or predicted quite accurately. Generally the phase transitions in the critical region is rather complex and difficult to measure and predict.
- Our research has provided much insight into this phenomena. The Supercritical CO2 Fluid Extraction method is based on high technology
- We are working in this area for the last 10 years.
- We have developed various vendors to supply us indigenously equipments such as high-pressure vessels up to 150 liters capacity, high-pressure CO2 pumps and transfer of material extraction and separate vessels and the related instrumentation.
- We are also extracting various herbs, medicinal plants and other natural products, which we have received from our customers.
- Our yield (quality of extracts) of raw material is at par with international standards. For kind reference results obtained by conducting experiments are enclosed here with as "Experiment data" ATTACHED
- We have already received order for supplying the complete system and also getting number of enquiries daily from various interested parties of this field.
- For analysis and characterization of the extract we have to set up laboratory equipped with latest and state of art lab instruments such as gas Chromatograph, HPLC, Mass Spectrometer and various other facilities to carry out this complex analysis of natural and diversified bio products.
- The laboratory analysis is very essential as it will give our customers/vendors( traders) an advantage in selling their products in the international market.
- **In conclusion,**

M/s CSL expertise has been applied to a wide variety of industrial applications including spices, pharmaceuticals etc. M/s CSL is a single-point-of-access resource for industries for SFE technology and we can provide complete solution for "Extraction by Supercritical CO2 method that includes:

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- Complete Plant machinery and instruments
- R & D Guidance needed to run the plants based on this indigenously developed technology
- Method of analysis the active ingredients available in the extracts of herbs and spices.