Processes • Equipment • Plants

Solid solutions for your chemical applications.
High expectations? We’ll go above and beyond.

Since 1959, Chemical Design, Inc. has raised the bar in applying innovative techniques to separation and purification applications. With more than 45 years experience in the chemical engineering industry, we bring a high level of expertise and insight to all our products and services, resulting in customized solutions that work for your process requirements.

CDI specializes in designing adsorption systems, including

- Air pre-purification for cryogenic nitrogen and oxygen plants
- LNG feed purifying plants
- Vent gas separation systems for polycrystalline silicon plants
- Vent gas recovery systems for epitaxial silicon wafer production
- Chemical and petrochemical purification and recovery systems
- Hydrogen purification and recovery systems

We also offer phosgene and nitrous oxide production systems and many other types of process plants.

But most importantly, CDI is dedicated to providing you quality products that are productive, efficient and economical – meeting and exceeding your expectations, every time.


CDI services provide the complete solution through high quality, cost-effective processes, equipment and plants.

**Custom Engineering** - CDI custom engineers all our units to rigorous industrial specifications. We start with your requirements, conduct a detailed engineering process, generate CADD drawings and ultimately supply a modular, skid-mounted, process plant that will help you save money and time in the field.

**Process Design** - CDI process designs are customized to solve your separation and purification problems. Our approach has often resulted in “first-of-a-kind” solutions. Some of these include:

- Air plant feed purification systems with molecular sieves
- Vent gas separation and purification systems for silicon plants
Removal of carbon tetrachloride from chlorine plant “sniff gas” residues

Removal of organics from acid vapors by adsorption

And although CDI’s specialty is the adsorption process, we can design and build many different kinds of process plants to suit your needs.

Estimating - CDI provides detailed and consistently accurate work estimates. Our computerized library of global technical and economic information allows us to quickly determine the size and scope of a project – providing you with fair, honest prices in short order.

Procurement - Depending on your project location, contract terms and availability of suitable quality suppliers – we can provide the right equipment, products and materials to you worldwide. Most of our sourcing takes place in the United States where we can most efficiently monitor quality control. We also design and build control panels required to operate our systems, complete with PLC programming. Electrical fabrication, system functional testing and optional export crating are completed prior to the shipment of supplies.

Construction - To maximize efficient construction of our plants, CDI minimizes field construction. We provide a completely functional, skid-mounted process system when we deliver our units. All you have to do is connect to the major process and utility interface points. And if multiple skids are needed to complete a system, interconnecting piping can be supplied.

Start-up - We supply complete operating manuals for every project, describing all operating procedures and providing detailed instruction for unit start-up and shutdown. This ensures that your system will function smoothly right from the start. When needed, CDI also provides supplementary engineering, as well as technical support and services, including troubleshooting and consultation on revamps and expansions.

Quality Program - To ensure the quality of all CDI equipment and plants, a detailed quality program – including required code documentation and important checkpoints during equipment fabrication – is available upon request.
CDI Plants. Highly refined.

Air Plant Feed Purifying Units

As the consumption of oxygen and nitrogen by steel, chemical, petrochemical, defense and electronic industries has rapidly increased over the past few years, air separation plant construction is at an all-time high. Cryogenic distillation of air into nitrogen and oxygen is still the most cost-effective method for large-scale production. CDI’s process removes water, carbon dioxide and other contaminants prior to entering the cold box. Additionally, trace hydrocarbons such as acetylene are eliminated before they can present a safety hazard.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Product</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate .................500 - &lt; 100,000 SCFH</td>
<td>Oxygen .......................&lt; 0.5 vppm</td>
<td>Completely skid mounted</td>
</tr>
<tr>
<td>Pressure ................Atmospheric</td>
<td>Water .......................&lt; 0.1 vppm</td>
<td></td>
</tr>
<tr>
<td>Temperature ..............-20°F - Ambient</td>
<td>Oxygen .......................Up to 5.0 vol. %</td>
<td></td>
</tr>
</tbody>
</table>

Argon Purifying Units

Argon present in the air is usually recovered as a by-product from an air separation plant. The most cost-effective methods for withdrawal of argon from the cold box create some residual oxygen. CDI supplies units that catalytically react the remaining oxygen with hydrogen. The resulting water is removed in dual-bed adsorption dryers.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Product</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>How per unit........1,000 - &lt; 100,000 SCFM</td>
<td>Moisture ..............................&lt; 0.1 vppm</td>
<td>Fully automatic, skid-mounted system</td>
</tr>
<tr>
<td>Pressure ................................40 - 2,700 psig</td>
<td>Carbon Dioxide ................. &lt; 0.25 vppm</td>
<td>Freestanding adsorbers</td>
</tr>
<tr>
<td>Temperature ..............................40 - 100°F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CDI Plants. Highly refined.
Hydrogen and Hydrocarbon Purifying Units

In today’s competitive marketplace, product purity is often dictated by your application. To meet these needs, refineries and chemical plants need to remove many trace contaminants to minimize undesired side reactions and resulting by-products. CDI’s cost-effective, prefabricated process plants can achieve the product quality you want. The plants are custom designed for specific applications and both manual and automatic operation is available, depending on your frequency of regeneration.

<table>
<thead>
<tr>
<th>Gas Treated</th>
<th>Impurities Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane</td>
<td>Water</td>
</tr>
<tr>
<td>Ethylene</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>Hydrogen/Saturated Hydrocarbons</td>
<td>Methanol</td>
</tr>
<tr>
<td>Hydrogen/Unsaturated Hydrocarbons</td>
<td>Chlorides</td>
</tr>
<tr>
<td>Hydrogen/Carbon Monoxide Syngas</td>
<td>Mercury</td>
</tr>
<tr>
<td></td>
<td>Ammonia</td>
</tr>
<tr>
<td></td>
<td>Trace Sulfur Compounds</td>
</tr>
</tbody>
</table>

Liquid Hydrocarbon Dryer Systems

Refineries and chemical plants frequently require moisture levels below 1 wppm to maximize downstream processing catalyst life and selectivity. CDI tailors the regeneration cycle to dry up excess liquid, ensuring years of trouble-free operation on fully automatic systems.

<table>
<thead>
<tr>
<th>Liquids Dried</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
</tr>
<tr>
<td>Hexane</td>
</tr>
<tr>
<td>Heptane</td>
</tr>
<tr>
<td>Propylene</td>
</tr>
<tr>
<td>Benzene</td>
</tr>
<tr>
<td>MEK</td>
</tr>
<tr>
<td>Silicone Oil</td>
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</tbody>
</table>
Silicon Vent Gas Recovery Processes

The production of silicon crystals generates a vent gas comprised primarily of hydrogen, chlorosilanes and hydrogen chloride. By combining a number of technologies, CDI has developed a process that separates the vent stream into easily recyclable components.

- Mixed chlorosilanes are recovered as a liquid stream suitable for distillation into trichlorosilane for reuse and silicon tetrachloride, which can be converted to trichlorosilane.
- High purity anhydrous hydrogen chloride is recovered, which is suitable for use in trichlorosilane production.
- Hydrogen is typically recovered with < 10ppm total contaminants and can be recycled to a trichlorosilane vaporizer without further treatment. In some applications, CDI has achieved < 1ppm total contaminants (99.9999% pure H₂).

This process also has environmental benefits – it creates no waste streams to dispose of and minimizes contamination opportunities because no outside streams, such as water and caustic solution, come into contact with the gas stream.

The use of this process with CDI’s special-grade activated carbon and properly selected construction materials results in the production of a very high quality, electronic-grade polycrystalline silicon.

High Purity Hydrogen Production Systems

The modern electronics, pharmaceutical and food industries require hydrogen purities exceeding 99.9999%. CDI can economically upgrade lower-purity process streams with our cryogenic adsorption process. Our process obtains hydrogen by removing impurities such as carbon monoxide, carbon dioxide, oxygen and carbon tetrachloride to the part per billion range.
Liquid Natural Gas Feed Purifying Units

In order to meet peak demands, many natural gas distributors store liquefied natural gas. Before natural gas can be liquefied, impurities such as water and carbon dioxide must be removed to prevent freezing in the cold box. Although amine solutions will remove carbon dioxide, and alumina will remove water, using molecular sieves to adsorb both impurities at the same time is more cost-effective.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Product</th>
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<tbody>
<tr>
<td>Flow rate ..............15 - 115MM SCFD</td>
<td>Moisture..........................&lt; 0.1 vppm</td>
</tr>
<tr>
<td>Pressure ..................Up to 1700 psig</td>
<td>Carbon Dioxide Concentration......&lt; 50 vppm</td>
</tr>
<tr>
<td>Temperature ..............Variable</td>
<td>Carbon Dioxide ......................Up to 2.0 vol. %</td>
</tr>
</tbody>
</table>

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<tr>
<th>Feed</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature ..............Variable</td>
<td>Carbon Dioxide ......................Up to 2.0 vol. %</td>
</tr>
</tbody>
</table>
Process Vent Recovery Systems

Many process vents contain components regulated by environmental authorities. CDI supplies carbon adsorption units and cryogenic condensation units, both of which can significantly reduce the contaminants in vented gas. In many cases, the recovered components can be recycled, minimizing raw-material cost. And as environmental regulations grow more stringent, CDI can apply these technologies to components such as methanol, acetone, methylene chloride, methyl bromide, ethyl bromide and many more.
Phosgene Plants

Phosgene is an intermediate chemical used during manufacturing of isocyanates, chloroformates, acid chlorides and specialty chemicals. Because phosgene is toxic, reliable facilities with minimum inventory are required for personnel safety.

CDI designs and builds plants that produce high-purity phosgene at a rate that ranges from a half-ton to over 50 tons per day. State-of-the-art bellows seal valves are used to almost completely eliminate emissions. And our compact, skid-mounted design allows the entire reaction system to be installed inside a controlled building, which acts as secondary containment for any remaining emissions. The complete plant safely produces phosgene onsite and on demand, eliminating transportation and storage concerns.

Hydrogen Chloride Purification Processes

Chlorination of organic compounds forms hydrogen chloride as a by-product. Residual organic compounds must be removed from the hydrogen chloride in order to meet purity requirements. CDI has developed a commercial process that reduces the organic content to less than 10 ppm. The purified anhydrous hydrogen chloride can then be sold as a by-product or used in other manufacturing processes.

Additional CDI Systems

- Ammonia Removal
- Anhydrous Hydrogen Chloride Recovery
- Caprolactam Liquid Drying
- Carbon Dioxide Drying
- Chlorine Purification
- Chloroform Purification
- Ethyl Bromide Drying
- Fluorocarbon Recovery
- Helium Drying
- Hydrogen Chloride Purification
- Krypton-Xenon Purification
- Methane Removal From Liquid Oxygen
- Neon Purification
- Nitrogen Deoxo Drying
- Nitrogen Oxide Production
- Silicone Oil Drying
- Solvent Drying
- Tritium Removal
- Ultra-high Purity Air Pre-purification
- Xylene Drying
CDI Global Supply. 
We go wherever you are.

CDI Customers. Good chemistry.

- AGA Gas
- Akzo Chemical
- ARCO Polymers
- Aerojet General Corp.
- Air Liquide
- Air Products & Chemicals
- Airco Industrial Gases
- Alabama Oxygen
- Allied Chemical
- American Cryogenics
- American Messer
- Amerigas
- Ansutech
- Atlanta Gas & Light
- BOC Process Plants
- Badger Co.
- Bechtel
- Big Three Industries
- Black & Veatch
- Brown & Root
- Bufete Industrial
- Burdett Oxygen
- CNG Transmission
- Celanese
- Champion Papers
- Chemetron
- Chinese Petroleum
- Chronopol
- Cincinnati Milacron
- Cloro de Tehuantepec
- Columbia LNG
- Conectiv
- Cosmodyne
- Diamond Shamrock
- Dofasco
- Dow Chemical
- DuPont
- Eastman Kodak
- FMC Corporation
- Formosa Plastics
- Foster Wheeler
- GE Silicones
- Global Octane
- H.K. Ferguson
- Hi-Silicon
- Hamilton Standard
- Himont
- Holox
- Hughes Tool
- Huls
- Jacobs Engineering
- Keystop LNG
- Kobelco
- Koch Refining
- LG Engineering and Construction
- Linde AG
- Liquid Air
- Liquid Carbonic
- Litvin
- Lotepr
- M. Setek
- M/T Technologies
- MEMC
- MG Industries
- MUD of Omaha LNG
- MW Kellogg
- McNeil Specialty Products
- Messer AGS
- Mitsubishi
- Mitsubishi Materials
- Mitsui
- Monsanto
- Motorola
- NASA
- NIPSCO Northern Indiana LNG
- Nan Ya Plastics
- National Cylinder Gas
- Novamont
- Occidental Petroleum
- Oriental Chemical Industries
- Osaka Titanium
- PCS Nitrogen
- PPG Industries
- Pennwalt
- Philadelphia Gas Works
- Praxair
- Pritchard
- Ranch Cryogenics
- Rhone Poulenc
- Rubicon Industries
- S & B Engineering
- S.E.H. America, Inc.
- SK Engineering & Construction
- Selox
- Shell
- Shin-Etsu Handotai
- Showa Denko
- Sichuan Xinguang Silicon
- Silicone Oil
- Smaprogetti
- Sobin Chemicals
- Sony
- Southern Connecticut LNG
- Stauffer Chemical
- Sumco USA
- Sumisho Fine Gas
- Sumitomo
- Superior Air Products
- TASC
- Taiwan Synthetic Petrochemical
- Tate & Lyle
- Tenneco Chemicals
- Tennessee Eastman
- Texas Instruments
- Thai Industrial Gases
- Toyo - Thai Corporation Ltd.
- Tyroc International
- Uhde GmbH
- Union Carbide
- Universal Industrial Gases
- University of Rochester Laser Lab for Energetics
- Vulcan Chemicals
- Wacker Chemtronics GmbH