Flokal® cryotechnology products

Issue 15- February 2004

We are ISO 9001: 2000 certified

Flokal® cryotechnology products

- Functions of the chill – from the past to the future!
- Chill with combinations with other extreme influences.
- We offer high quality cryotechnology equipment for the full circle of cryoproduction!

We invite you into the world of our services!
E-newsletter free subscription

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ABOUT US

FLOKAL® - the ultimate resource for:

- **MFC's** accessories - **Valves** & Accessories - **Gas-systems** & Accessories;
- **Thermo-elements** (spike and profile)
- Gas/Liquid Filtration and Purification & Accessories
- **Vacuum** measure and control devices

Functions of chill – from the past to the future!

The low temperatures by itself or in combination with the other technologies make exceedingly influence turned out to be efficient in chemistry and technology for reception as usual products, so and unique products.

The natural chill was yore used for water freeze, at food conservation and for steels development.

The Phenomena of the freeze of water under it quick evaporation in vacuum has allowed D. Flattery (1810) to build first installation for preparation of the artificial ice. In 1875 K. Linde was created ammonium compressor refrigeration machine, which initiated modern cryogenic technology, using temperature below 120 K.

Intensive development of the refrigeration technology has done the chill at present economic and technically available. Fundamental studies in the field of cryochemistry and cryophysics (that is to say chemistry and physics of the low temperatures) has opened the outlook for making varied chemist-technological processes with use of influence of the low temperatures.

In chemistry and chemical technology, as a rule, are using the low temperatures within the range of from 270 before 120 K (the moderate chill) and relatively seldom temperature below 120 K (the deep chill). In laboratory conditions for reception of the moderate chill are using the mixture of the ice with salt, acid or alkali, in which cooling is reached with help of the ice melting. The more low temperatures (the order 200 K) are getting, with using of a cooling mixture of the hard carbonic acid (dry ice) with alcohol or airwaves. Finally, for reception of low and ultra low temperatures in technical scale are using the processes of the expansion of the compressed gas, thermoelectrical phenomena or adiabatic degaussing, which are realized in special refrigeration machines. Using of the low temperature influences allows to solve the row in principal important problems, including translate the atoms and molecules in electronic condition, the impossible under usual temperature; realize the specific mechanism of the interaction with participation molecular complex; select the products of the interaction, thermodynamic and kinetic stable only under low temperature.

Solely, the big interest has caused the opening to anomalous high reactionary ability of the molecules in ranked system (the formaldehyde, styrene) at the temperature, close to absolute zero. This effect (so named by tunnel transition) possible explain the principle possibility of the forming the complex organic molecules in condition of the cosmic chill (before biological evolution).

When we talk about perspective of using the chill in chemistry and chemical technology, conditionally we select three directions:

- Low temperature influence emerges by itself that is to say does not be accompanied others, not simple physical influences;
- Chill is combined with heating;
- Chill is combined with other extreme physical influence.

In the first direction of the most success is reached, with using the chill in division of the gas mixtures. First of all, amongst them, there is low temperature rectification of the fluid air in production of the nitrogen and oxygen. Last times, the interest was increased vastly to fluid

hydrogen. It is perspective for using in cryogenic systems, which is supporting ultra conductive conditions of the alloys. Besides this, it is possible to use fluid hydrogen as chemical reagent of low temperature processes and clean source to energy, as for passenger transport and finishing for cosmic rockets. At the preparation of the high-quality lubricating technical oils, beforehand they are freezing for deleting the admixtures of the paraffin. The crystallizations processes on chill are used in production of the salts and mineral fertilizers, as well as many organic products, including phenols, solicit acid, sulpha acids, pesticides, mothball and dye staffs. Scientist and technologists make broad front of the work for creation economic justified cryotechnologies of the sea water desalinisations.

The chill in enormous scale is used in chemical industry for preparation of ammonia and carbon emaciates, under catalytic conversion of the methane, cationic polymerisation isobutylene and his copolymerisation with diens to achieve the stereo regular rubber with given characteristic. The exclusive prospects in the field of organic and inorganic syntheses were opened in connection with development of the preparative and matrix cryochemistry, which originally developed by itself, but now they are so closely and complement each other. In preparative cryochemestry is used low temperature socondensation of the active particles with stable chemical connection, which are got under high temperature. Matrix crychemistry is founded on the low temperature socondensation of the active particles in abundance inert material. Next chemical conversions are causing with condensation of the additional reagent, heating or irradiation. This method allowed, as on order, to get the molecules NiN_2, PdO_2, HES_{14}, $Pt(CO)_4$ and many others with unusual type of chemical connection.

Solely perspective are cryochemistry processes (the reactions of isomerisation, hydration and dispercentalization of the organic connection), which are catalyzed with atoms of heavy metals. There are a lot of processes, in which low- and high temperature influences are combined. Amongst them stand out so named cryochemistry technology of solid phase materials. She is founded on well balanced combination of the chill and heats, but chill itself is used for prevention of the uncontrolled change intermediate and target products and conscious management of their characteristics. This technology presents itself whole complex of the processes, amongst which main is crystallization that is to say freeze the solution of the salts of metal making components, providing greatly quick solid making both solvent, and solutes. This method was used in the first time at ferrite syntheses hereinafter became the base precision technologies for the most varied material (fig. 1).

Cryochemistry powders, aside from high chemical homogeneity have a lot others values that allow get on their base high-quality ceramics, including optical transparent, on base Pb zirconate with help of titanium oxides.

Ceramics on base polyaluminiat of the sodium, which is got by the cryochemical method turned out to be stabile even under long boiling in concentrated chamois acid. The specified procedure has allowed to get the special form of the substance, capable to act as the detector elements an electrochemical detector of the hydrogen.

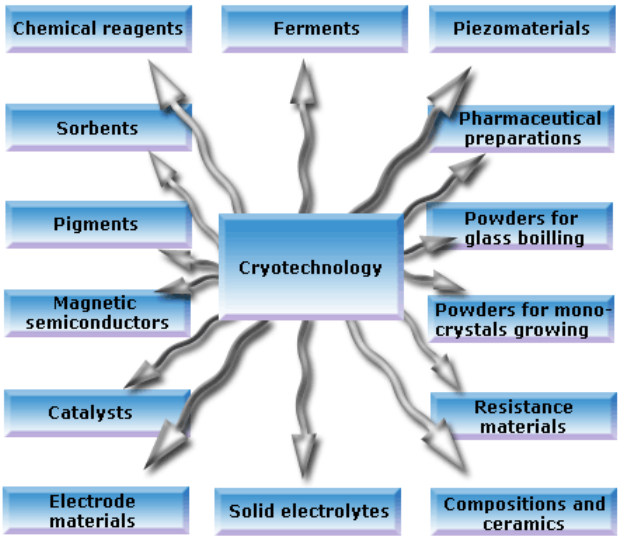

Figure 1.

Amongst the last achievements of the cryochemistry technology there is a reception superconductive oxide ceramics on the base of multycomponent systems of the Pb-Bi-Ca-Sr-C-O type.

Some phenomena discovered in the course of the cryochemistries studies, present the independent interest for inorganic chemistry. Amongst them, fluid-phase dehydration and spinoidal disinteration in quickly cooled solution of the electrolyte, changing of the mechanism of topochemicals processes in product of cryochemical syntheses, existence crystalgydrated structures with anomalous deficit of water. Versatility of the using of cryochemical technology is illustrated by fragment of the periodic table (fig. 2), where painted symbols chemical element, which oxidises were received as individuals or in combinations with the other oxides with use acceptance of the cryochemical technology.

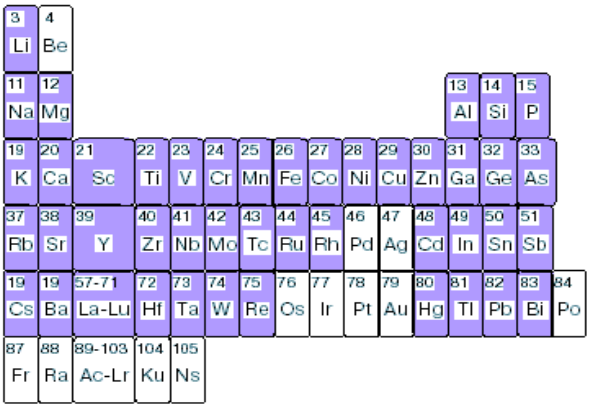

Figure 2.

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Chill with combinations with other extreme influences.

Here follows to say first of all about low temperatures processes radiation- and photoinitialized polymerisation of the hard phases, about ion polymerisation in the first place, which with of complex making substances runs on mechanism of "alive chains". The Phenomena of isotope selectivity of the photochemical reactions under low temperature can already be in the near future used for syntheses enriched certain isotope of the connection. Combined use of the low temperatures and high pressures has allowed realize solid phase polymerisation of the connections, which could not polymerise in fluid phase. Regrettably, broad multifunction using the low temperature and high pressures prevent the technical difficulties, which in row of the events managed to avoid, with help of quasi hydrostatic mode (the compression under moderate temperature with the following quick freeze of the system). The big interest presents the studies, shown possibility of the compression material to account their relatively weak heating under low initial temperature. It is expected that realization of this principle will bring about possibility of the compression before 10^5 Pa and above. Low temperature synthesises, which are actuated with electrical energy and blast, are perspective. For instance, processes, occurring in mixture of the fluid nitrogen, oxygen and bromine, which bring about forming the unusual products Br_2O_3, N_2O_3, BrO_3, $3NO_2$.

CONCLUSION

The prospects of the use the chill in technologies are closely connected with reception and conservation of the high quality food-stuffs. Now does not cause the doubts that cryoconservation of the products of the biological origin, and in the first place cryoconservation of the food-stuffs, is a progressive trend. Main attention deserves technology of sublimated conservation (drying) for conservation biologically valuable products (meat, fish, vegetables, fruits, milk, coffee, tea, juice and others.). Unlike traditional methods of conservation, products of

sublimated drying are characterized by small specific mass and quick reconstruction quality. In biology and medicine is solely important technology of conservation shelters, maternal milk, back brain, development efficient cryoprotectors, excluding crystallization in biological liquid under their freeze, as well as using the chill for destruction of the malignancies crystallizing with ice. Crowding intercoupling physical, chemical and biological phenomena allows to confirm that study of the effect of cryoinfluence in any concrete area can bring about fundamental opening that, in turn, required for creation of technologies of the future.

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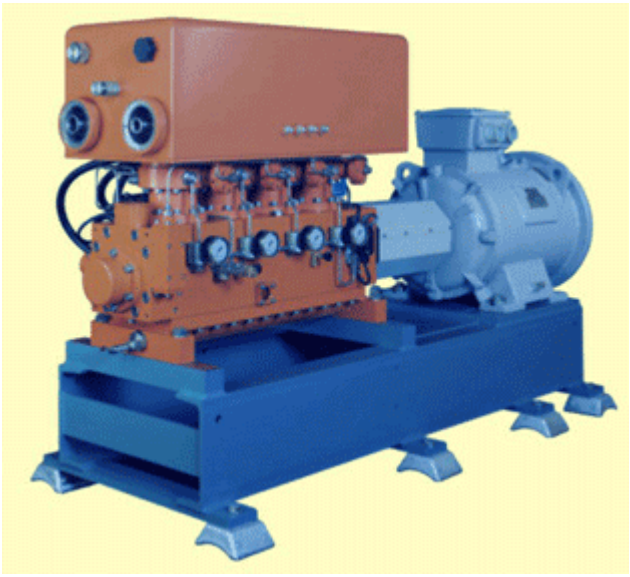
We offer high quality cryotechnology equipment for the full circle of cryoproduction!

Process cryogenerator

With our Process Cryogenerator, you own your own cold source. It puts a cold spot in your process, fueled by ours economical cooling power.

A new standard of performance.

The fully automatic, stand-alone Process Cryogenerator offers truly performance-plus technology. With features that are only available as options on competitive systems and with some features that other manufacturers can't even offer at all!



For instance, with the our Process Cryogenerator and its Stirling controller, you get: 5 minute start-up to full cold production; lowest energy consumption; low noise level; cooling and liquefaction capability; cooling to 65-200 K; easy integration in your process; single switch and remote control operation; fully automatic start and stop; integrated system diagnostics; automatic restart after power failure

Industrial manufacturers can take advantage of stand-alone technology to make their processes more reliable and efficient. The Process Cryogenerator (PC) is a stand-alone closed cycle cryogenerator that lets you efficiently cool a liquid or a gas in a process, to any temperature. Simply hook it up and the SPC will give you the cold source you need. Without affecting your process. The PC-1 and PC-4 are cycle based, one stage cryogenerators, generally used for cooling in the temperature range of 65-200 K. The cold production (Watt) is a function of the (process) operating temperature, as given in the cold production graph of the PC-1 and the cold production graph of the PC-4. The electric power consumption of the PC's depend on the operating temperature too. If the operating temperature is high the electric power consumption is less.

PC-T: Two stage Process Cryogenerators

PC-T: Two stage Process Cryogenerators.

We offer two types of two stage cryogenerators for ultra low temperature cooling: the PC-1T and the PC-4T.

PC-1T

The PC-1T is a low temperature, one cylinder, two stage cryogenerator based on the Cycle. The temperature range is 80 K on the first stage and 20-40 K on the second stage. The PC-1T is generally used for process cooling, but can be adapted for liquefaction of industrial gases. In case of process cooling, the PC-1T is equipped with transfer fans to transfer a cold gas (generally helium gas) from the PC-1T to the application and back.

PC-4T

The PC-4T is a low temperature, four cylinder, two stage cryogenerator based on the Cycle. The temperature range is 80 K on the first stage and 20-40 K on the second stage. The PC-4T is generally used for process cooling, but can be adapted for liquefaction of industrial gases. In case of process cooling, the PC-4T is equipped with transfer fans tot transfer a cold gas (generally helium gas) from the PC-4T to the application and back.

We provide engineering support to ensure a perfect integration in your process

Optionals:

Chiller for cooling water supply; Transfer hose of various length; Cold head for liquefaction of industrial gases. e.g. Ne and H_2; Engineering support; Spares and tools for preventive and corrective maintenance.

Gas liquefier

With the Gas Liquefier (GL), you can liquefy virtually any gas. Wether it comes directly from the source or from evaporation. And, when applied in a closed-loop to recondense the coolant liquid gases, you don't lose any coolant at all! The GL-1 and GL-4 are plants based on the PC-1 and PC-4 and are specially designed for applications to liquefy a gas from an external gas source and to transfer the liquid gas to an application or storage vessel.

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A new standard of performance.

The fully automatic, stand-alone gas liquefier offers truly performance-plus technology. With features that are only available as options on competitive systems and with some features that other manufacturers can't even offer at all!

With the Gas Liquefier you get: 5 minute start-up to full cold production; lowest energy consumption; low noise level; cooling and liquefaction capability; cooling to 65-200 K; easy integration in your process; single switch and remote control operation; fully automatic start and stop; integrated system diagnostics; automatic restart after power failure.

The most efficient way to liquefy the gases in your process.

The GL reliquefies expensive evaporated gases and stores them, putting extra product and money back into your operation. Connected to your gas generator, the GL liquefies your gases for on-site storage. You can use it to cope with peak demands or as a liquid backup. You get the gas you need, whenever it is needed. It is the most reliable way to secure your process.

Liquid nitrogen production plants

Our newest generation of liquid nitrogen production plants (LIN) is the most reliable. A fact we attribute to the support we receive from the global community in refining and improving our solutions.

Control your own liquid nitrogen supply

Ours vision is to make you fully self-sufficient. A LIN lets you produce the liquid nitrogen you need, as you need it. It regulates itself, so you don't even have to tell it when to start producing. When you don't need as much liquid nitrogen, it is stored away for future use. You have full control of your own liquid nitrogen supply.

A new standard of performance

The new fully automatic, stand-alone, liquid nitrogen production plant is truly performance-plus technology - with features that are only available as options on competitive systems. And some features that other manufacturers can't even offer at all!

With the Liquid nitrogen production plant you get: single switch operation; fully automatic start and stop; 10 Minute start-up; lowest energy consumption; storage tank with level control; integrated system diagnostics ; low noise level; full production guaranteed to 45°C; automatic restart after power failures.

LIN-1 Compact

The LIN-1 Compact is our most popular, plug and play solution. It takes up little space, but has a big effect on your ability to produce and store liquid nitrogen. It is single skid mounted, pre-calibrated and ready to go to work. Simply connect water and power and start producing your own liquid nitrogen.

The LIN-1 Compact includes a compressor, an air separation unit, a Process Cryogenerator (PC-1), and a 300 liter storage vessel. It produces at least 10 usable liters per hour of liquid nitrogen of 99% or better purity at nominal operating conditions. The pressure in the vessel can be set from 0.3 to 3 barg, increasing the liquid production to 14 l/hr at a purity of 98% or better. The liquid is dispensed through a flexible hose by opening a valve. The rated power is 16 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routinechecks between maintenance intervals, which is 6,000 operating hours. Higher production and better purity than any other system in its category.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; spares and tools for preventive and corrective maintenance; liquid nitrogen handling package (gloves, protection glasses).

LIN-1

The LIN-1 produces at least 10 usable liters per hour of liquid nitrogen of 99% or better purity at nominal operating conditions. The pressure in the storage vessel can be set from 0.3 to 5 bar(g), increasing the liquid nitrogen production to 16.5 l/h at a purity of 98% or

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better. The liquid nitrogen is dispensed through a flexible hose by opening a valve. The rated power is 16 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.

The LIN-1 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying nitrogen gas and the proven 1-cylinder PC-1 Process Cryogenerator as liquefier. The plant includes a 500 l storage vessel. The LIN-1 is also available in an Extendible version. By adding a second SPC-1 the plant becomes a LIN-2. With only one cryogenerator the purity is better than 99 %.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; second PC-1 to increase production; spares and tools for preventive and corrective maintenance; liquid nitrogen handling package (gloves, protection glasses).

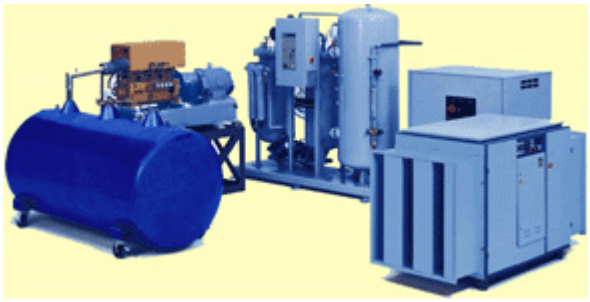
LIN-2

The LIN-2 produces at least 21 usable liters per hour of liquid nitrogen of 99% or better purity at nominal operating conditions. The pressure in the storage vessel can be set from 0.3 to 5 bar(g), increasing the liquid nitrogen production to 33 l/h at a purity of 98% or better. The liquid nitrogen is dispensed through a flexible hose by opening a valve. The rated power is 32 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.

The LIN-2 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying nitrogen gas and the proven 1-cylinder PC-1 Process Cryogenerator as liquefier. The plant includes a 1,000 l storage vessel.
Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; spares and tools for preventive and corrective maintenance; liquid nitrogen handling package (gloves, protection glasses).

LIN-4

The LIN-4 produces at least 44 usable liters per hour of liquid nitrogen of 99% or better purity at nominal operating conditions. The pressure in the storage vessel can be set from 0.4 to 5 bar(g), increasing the liquid nitrogen production to 75 l/h at a purity of 98% or better. The liquid nitrogen is dispensed through a flexible hose by opening a valve. The rated power is 63 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.



The LIN-4 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying nitrogen gas and the proven 4-cylinder PC-4 Process Cryogenerator as liquefier. The plant includes a 2,000 l storage vessel. The LIN-4 is also available in an Extendible version. By adding a second PC-4 the plant becomes a LIN-8. With only one PC-4 the purity is better than 99 %.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; second PC-4 to increase production; spares and tools for preventive and corrective maintenance; liquid nitrogen handling package (gloves, protection glasses).

LIN-8

The LIN-8 produces at least 89 usable liters per hour of liquid nitrogen of 99% or better purity at nominal operating conditions. The pressure in the storage vessel can be set from 0.4 to 5 bar(g), increasing the liquid nitrogen production to 151 l/h at a purity of 98% or better. The liquid nitrogen is dispensed through a flexible hose by opening a valve. The rated power is 126 kW if tap water is used. Operators only need to replace filters and

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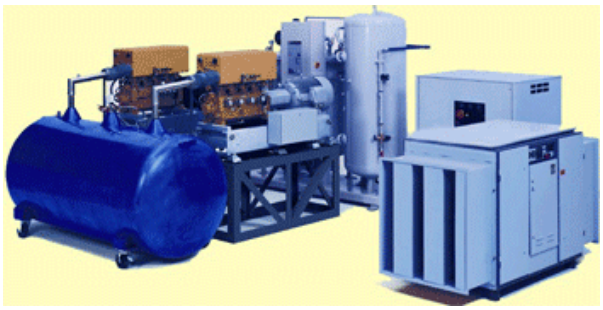
compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.



The LIN-8 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying nitrogen gas and the proven 4-cylinder PC-4 Process Cryogenerator as liquefier. The plant includes a 2,000 l storage vessel.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; spares and tools for preventive and corrective maintenance; liquid nitrogen handling package (gloves, protection glasses).

- **PLN 108S liquid nitrogen production plant**

LIN-1 Compact

The liquid nitrogen production of the PLN 108S is based on cryogenic separation. Air is separated in oxygen and nitrogen in a cryogenic seperation column. The nitrogen is liquefied in the cryogenerator and fed back to the column. It is then used to provide extra refrigeration required for the separation.

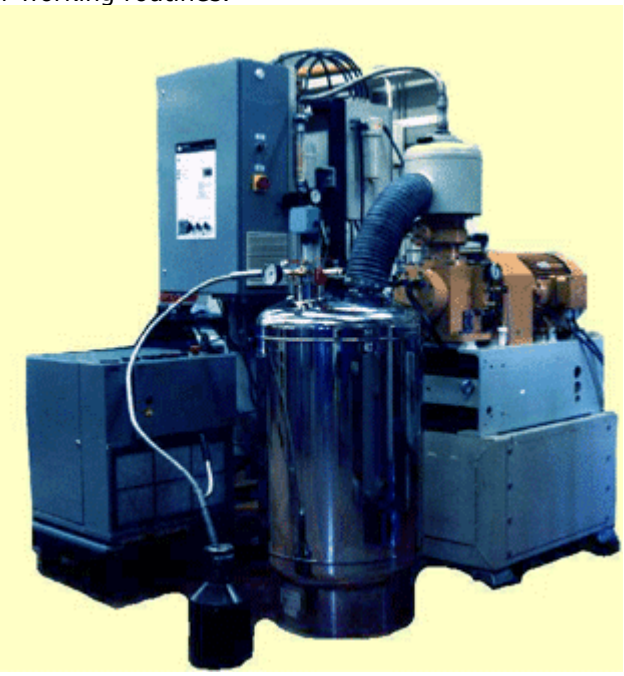
PLN 108S:

Fully automatic and self-contained liquid nitrogen plant;. Unsupervised operation after start-up.
The PLN 108S system consists of a 1-cylinder Stirling cryogenerator as a liquefier and a separation column to separate the liquid air into the liquid nitrogen product.

Optionals: chiller for cooling water supply; 300 l horizontal storage vessel with pressure build up system; spares and tools for preventive and corrective maintenance.

- **PLN/LIN conversion and upgrading sets**

With the PLN/LIN Conversion System, the changeover to a new way of operation is rapid. And thanks to the professional approach of our specialist engineers, conversion can be achieved with minimal disruption to your working routines.



The benefits of the change, will however, be noticed: automatic start/stop/standby - single switch operation; automatic start up after power failure; fast start up - 5 minutes to liquid production; no defrosting or purging; fully automatic operation; suitability for intermittent use.

After conversion the production rate goes up 10-20%, depending the condition of the cryogenerator. A PLN can run continuously for max. 120 hours and then needs defrosting. Because the LIN Conversion doesn't need defrosting, the annual production can be doubled due to the much longer continuous running times.

The combined benefits of the PLN/LIN Conversion System can mean quite simply, you're in operation faster. And you're in continuous operation too. All of which means a big boost in output... and thus, your profitability.

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LAIR: liquid air production plants

Safe liquid air supply

Equipped with the innovative AirLock, the stand-alone LAIR plants are truly performance plus technology. Featuring high energy efficiency, high productivity, controlled operation, low maintenance and only a 10 minute start-up time. They are the only way to make your liquid air production self sufficient and highly reliable. A LAIR frees you from all inconveniences. It is comperatively small, and needs no gas reserves whatsoever: it simply uses air. It can be fitted to almost any existing liquid gas system or incorporated in new developments.

High on thrills, low on maintenance.

Liquid air enables you to realize revolutionary new special effects. It does not deplete oxygen in the environment and becomes breathable air again. So if you want to create crowd-pleasing special effects, with liquid air it is perfectly safe to combine fog, smoke ánd flames.

Equipment is characterized by an extremely high degree of safety and reliability. It is also straightforward and easy to use, so no special operators are required. New production techniques greatly decrease the frequency of maintenance intervals. A single plant gives you your own reliable, problem-free and consistent supply of liquid air for many years to come (more than half the installed Stirling cooling plants have been in operation for more than 15 years). Plus you have the constant reassurance of Stirling's global service network as a back-up.

Cold Cabinets

The security of absolute certainty

Cold Cabinet enhances the operational properties of metal components. It cools large batches of product down to -190° C and heats it up again to ambient temperature. The process is fully automatic and fully PLC-controlled, thus offering high quality assurance to the user. Total reliability is essential in metal treatment processes. Stirling equipment uses highly efficient and simple technology. The straightforward construction means that reliability is designed in. New techniques have been harnassed to further optimise the equipment and to greatly decrease the frequency of service intervals. The high-end Cold Cabinets are allways tailormade and built for years of reliable operation.

Metal components are often given very specific thermal treatment to enhance their operational properties. Cold and heat treatment influences hardness, tensile strength and dimensional stability, due to structural changes within the material. Although heating is an essential part of the process, cold treatment often gives the finishing touch. Subzero cooling nowadays finds wide application in the metalworking industry to improve the structure and properties of metals. Usually, cryogenic treatment is carried out as part of the heat treatment or hardening cycle of the machined product. The final effect of cryotreatment is dependent on such factors as the composition of the steel,

the heat treatment cycle and the final use of the product. Hardness, abrasion resistance, fatigue resistance, life improvement and dimensional stability, it all are properties that are amenable to improve. After heating the steel (to austenitize the carbides in the steel) and quenching (to transform the austenite into martensite) there is still a quantity of non-transformed austenite present. This 'retained austenite' can, over a period of time, cause dimensional growth and cracks. So tempering is necessary to achieve full hardness of the steel. After reheating there will still be some austenite to be retained. Low-temperature treatment, if carried out at a sufficient low level, will either cause complete transformation or result in substantially better tempering (see figure B). The cryotreatment becomes more necessary as the carbon and chromium contents of het steel are higher. For many steels, particularly the high-alloy steels, temperatures between -120 °C and - 190 °C are necessary to realize complete transformation. Of course gradual cooling is essential to avoid cracking under such extreme conditions. After subzero cooling the usual tempering can be carried out and the part can be machined to final dimensions.

LOX: liquid oxygen production plants

A new standard of performance.

Our newest generation of liquid oxygen production plants (LOX) is the most reliable in its kind. Using truly performance-plus technology, with features that are only available as options on competitive systems. And some features that other manufacturers can't even offer at all!

With the liquid oxygen production plant you get: single switch operation; fully automatic start and stop; 10 Minute start-up; lowest energy consumption; storage tank with level control; integrated system diagnostics; low noise level; full production guaranteed to 45°C; automatic restart after power failures.

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LOX-1

The LOX-1 produces at least 8,5 usable liters per hour of liquid oxygen. The purity is USP XXII Oxygen 93% at nominal operating conditions. The pressure in the storage vessel can be set from 0.3 to 4 bar(g), increasing the liquid oxygen production to 13.5 l/h. The liquid oxygen is dispensed through a flexible hose by opening a valve or is evaporated to become gaseous oxygen again. The rated power is 48 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.

The LOX-1 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying oxygen gas and the proven 1-cylinder. PC-1 Process Cryogenerator as liquefier. The plant includes a 1,000 l storage vessel.

LOX-2

The LOX-2 produces at least 17,5 usable liters per hour of liquid oxygen. The purity is USP XXII Oxygen 93% at nominal operating conditions. The pressure in the storage vessel can be set from 0.3 to 4 bar(g), increasing the liquid oxygen production to 27,5 l/h. The liquid oxygen is dispensed through a flexible hose by opening a valve or is evaporated te become gaseous oxygen again. The rated power is 78 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.

The LOX-2 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying oxygen gas and two proven 1-cylinder. PC-1 Process Cryogenerators as liquefiers. The plant includes a 1,000 l storage vessel.

LOX-4

The LOX-4 produces at least 36,5 usable liters per hour of liquid oxygen. The purity is USP XXII Oxygen 93% at nominal operating conditions. The pressure in the storage vessel can be set from 0.4 to 4 bar(g), increasing the liquid oxygen production to 57 l/h. The liquid oxygen is dispensed through a flexible hose by opening a valve or is evaporated to become gaseous oxygen again. The rated power is 120 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours. The LOX-4 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying oxygen gas and the proven 4-cylinder PC-4 Process Cryogenerator as liquefier. The plant includes a 2,000 l storage vessel.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; spares and tools for preventive and corrective maintenance; liquid oxygen handling package (gloves, protection glasses); cylinder filling station.

LOX-8

The LOX-8 produces at least 73 usable liters per hour of liquid oxygen. The purity is USP XXII Oxygen 93% at nominal operating conditions. The pressure in the storage vessel can be set from 0.4 to 4 bar(g), increasing the liquid oxygen production to 114 l/h. The liquid oxygen is dispensed through a flexible hose by opening a valve or is evaporated to become gaseous oxygen again. The rated power is 250 kW if tap water is used. Operators only need to replace filters and compressor oil and perform routine checks between maintenance intervals, which is 6,000 operating hours.

The LOX-8 is based on the highly efficient Pressure Swing Adsorption (PSA) system for supplying oxygen gas and two proven 4-cylinder PC-4 Process Cryogenerator as liquefier. The plant includes a 2,000 l storage vessel.

Optionals: chiller for cooling water supply; generator set for power supply; voltage stabilizer for utility power stabilization; spares and tools for preventive and

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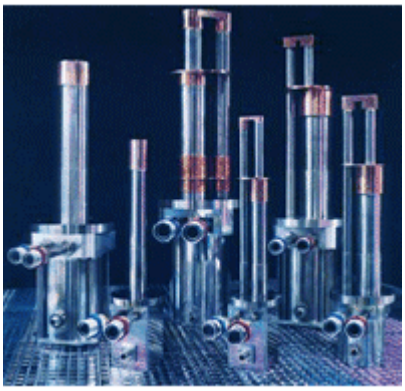
corrective maintenance; liquid oxygen handling package (gloves, protection glasses); cylinder filling station.

- **Cryorefrigerators**

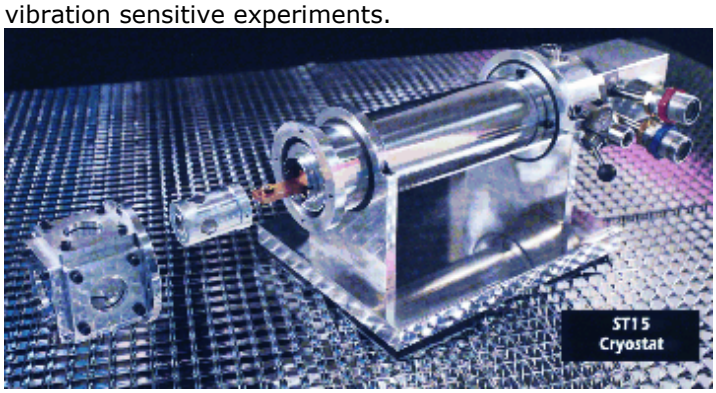
We manufacture single and two stage cryorefrigerators based on both the Pulse Tube and the Gifford-McMahon Cycles. We offer low temperatures down to <2.7K and capacities as high as >300 watts at 77K. We now represent a company which manufactures a closed-cycle dilution refrigerator offering 0.050K.



Pulse Tube Cryorefrigerators (PTR) are now available in single and two stage models. All PTRs reach cryogenic temperatures without the displacers that cause vibrations. This reduction of the cold moving parts increases the mean time between maintenance, while decreasing noise and vibration. The PT405, a two stage PTR, obtains a low temperature of < 2.7K, in both 50 and 60 Hertz power regions. We also offer the PT805 which cools to <8K. Our new PT60 is a single stage PTR which cools to <30K, has 60 watts of capacity at 77K, for an input power of 3 kW. Ours Gifford-McMahon Cycle Cryorefrigerators, as shown in the above photograph, are also available in single or two stage models. The single stage G-M's, the AL Series, reach a low temperature of either 10K or 25K in 20 minutes and are maximized for price and capacity from 10-80K. The two stage G-M's, the GB Series, cool down to 6.5K on the second stage with the first stage supplying cooling from 40-80K. When cooling devices to below 20K with the second stage a

- **Cryostats**

For cryogenic laboratory experiments, we manufacture standard cryostats capable of cooling your sample to 3K, eliminating the need for liquid helium. The new Pulse Tube Cryostat, the ST405, reduces vibrations to the lowest levels ever available in a closed cycle cryostat, simplifying many vibration sensitive experiments.



Our cryostats are easy to operate and cool reliably to the required temperatures. All standard cryostats are easily modified for use in multiple experiments. We offer many options to help you adapt the cryostat into your laboratory.The complete cryostat, along with the temperature controller of your choice, is assembled and tested. For the unique experiment at cryogenic temperatures, we can offer personal service to design and build your custom cryostat.

- **Helium Recondenser**

We have developed a new Helium recondenser. The concept is simple: insert it into a liquid Helium dewar and recondense the Helium vapor. Therefore, you no longer need to refill your dewar with expensive liquid Helium. The recondenser eliminates the boil off of up to 12 liters/day using <5 kW of electrical power and water cooling. The PT405 Pulse Tube Cryorefrigerator has no moving parts so it does not excite vibrations into your dewar. The PT405 Recondenser is the most efficient method to maintain the liquid level inside your dewar. The normal method for Helium liquefaction is less efficient because the liquid Helium which evaporates is allowed to warm all the way up to room temperature before it enters the Helium liquefier. The Helium must then be cooled all the way back down to 4.2 K before it is reliquified. With the PT405 Recondenser, all the refrigeration power is used to change the phase of the Helium from 4.2 K gas to 4.2 K liquid. The PT405 Cryorefrigerator which powers the PT405 Recondenser is a closed cycle cryorefrigerator. Therefore, the Helium in your dewar does not mix with the working fluid inside the recondenser. This eliminates many of the maintenance and reliability problems inherent in Helium liquefiers.

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