CRYOGENIC INDUSTRIES

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Climate Affects the Selection of Ambient Air Vaporizers

hen designing ambient air vaporizers, many factors need to be considered. The environmental effect is one such criterion. When designing and specifying fan-assisted and natural draft ambient air vaporizers, four main climate zones are used: tropical, Mediterranean, humid continental, and marine. Each of these zones, however, may contain micro climate zones with signi cantly different climate than the surrounding area.

Wide gap na

In discussing climatic effects, a basic understanding of the principles of ambient air vaporizers is necessary. Fan-assisted vaporizers utilize forced convective heat transfer whereas natural draft ambient air vaporizers utilize natural convective heat transfer. Natural convective vaporizers are typically manufactured with three different n spacings, depending on how long the vaporizers are going to be operated before complete defrost is achieved. Standard spaced vaporizers typically operate less than 24 hours before complete defrost and have a n tip-to-tip air gap roughly 1.5” (38 mm). [Figure 1]

The following are basic vaporizer design considerations when dealing with the issues of location and duration of operation of ambient air vaporizers. Other considerations also must be

The main difference from the tropical zone is the low moisture content here can exist six to nine months of the year. Several unique weather characteristics result from this. Infrared radiation which escapes from the atmosphere at night often

CD’S Model AC/TC-34 and TC-34.2 submerged pumps are a sealess design with integral pump and motor vertically mounted in a sump or tank. The sealess design meets or

Heat Exchanger Research

Heat exchanger fouling due to scale formation is a common problem. A particularly severe application is heat transfer from brine flows. Generation of power from low temperature geothermal resources requires the transfer of heat from the brine to a binary power system. Conventional binary power systems are limited in the amount of heat that can be transferred for conversion by the boiling process. Advanced power cycles such as Energent's Variable Phase Cycle or the Kalina cycle are able to capture more heat from the geothermal resource and produce more power. The only limitation to these advanced cycles is the extent to which the brine temperature can be lowered in the heat exchanger without producing scaling. These advanced cycles have the potential of producing 20 – 30% more power than a conventional binary power system.

To determine the best method of scale reduction, a research program was carried out at a geothermal resource having a high scaling potential. The primary source of scaling was silica which was found in the brine at a level of 528 ppm.

A scaling test system with several experiments was designed and operated at Coso geothermal resource with brine having a high scaling potential. Several methods were investigated at the brine temperature of 235ºF. The experiments involved injection of four potential anti-scaling chemicals; operation of an electromagnetic device; and the circulation of abradable balls through the brine passages. The test apparatus is shown in Figure 1. Brine from a power plant separator flowed through tubes which had the scale reduction methods introduced. The tubes were immersed in a cooling water bath to reduce the temperature. The temperature of the brine was reduced to an average temperature of 125ºF.

The most promising method was found to be circulation of the abradable balls through the brine passage. Abradable balls are routinely used for the scaling of condenser tubes. The balls used for the brine descaling had a special high temperature rubber formulation with hard particles inserted in a sponge matrix. Table 1 shows the results of operation for 30 days of flowing brine. As can be seen, the abradable balls resulted in the lowest scale buildup at the tube exit. Two of the chemicals had a low scale buildup at the inlet of the tube, but resulted in a buildup of more than three times that of the abradable balls at the exit. A probable reason is the recommended injection rate was too low. Future tests will be done increasing the vendor's recommendation for the injection rate. However, chemical injection is costly and has environmental consequences. Increasing the rate can substantially increase the operating cost.

The key result is the ability to operate at the low-temperature 125ºF with only a moderate buildup of scale. For advanced low-temperature cycles, such as the Variable Phase Cycle or Kalina Cycle, the lower brine temperature will result in a 20-30% increase in power production from low temperature resources.

A preliminary design of an abradable ball system ("ABS") was do
for the heat exchanger of the 1 megawatt VPC system at Co
resource. The ABS will be installed and demonstrated in Phase
of this project, increasing the power production above that which
possible with the present 175ºF brine outlet limit.

A hermetic turbine generator (TGH) was designed for the next ph
of the project. This unit will use the working fluid (R134a) to lubrica
the bearings and cool the generator. The 200 kW turbine direc
drives the generator, eliminating a gearbox and lube oil syste
Elimination of external seals eliminates the potential of leakage of
refrigerant or hydrocarbon working fluids resulting in environment
improvement. A similar design has been demonstrated by Energ
in a binary waste heat recovery system.

Operation in Phase 2 of the TGH with and without the ABS system
demonstrate an increase in geothermal resource productivity for t

The Use Of SF_6 to Assure Reliable Delivery of Power to Home and Industry

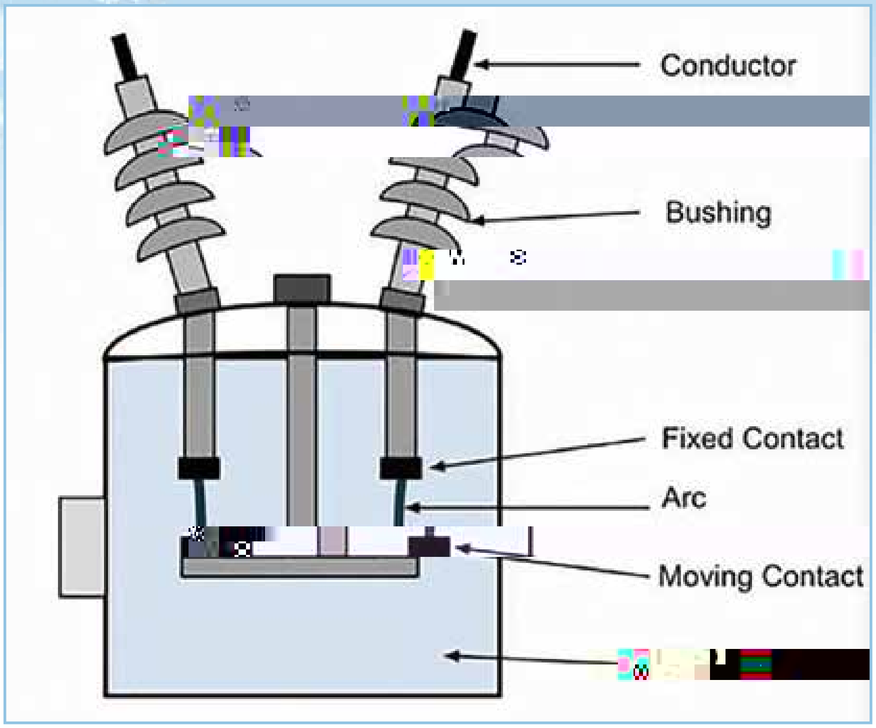

Figure 1 - Bulk Oil Type Circuit Interrupt Switch

Moving vast amounts of electrical energy over many miles from electrical generating plants to the end user requires the power to be "stepped up" to 230kV, 345kV, 500kV (thousand volts), and higher. It is then sent along transmission lines to many local sub-station distribution centers where the power is "stepped down" to customer usable levels. It is necessary for the sub-station to be able to turn these high voltage levels of power off and on as needed. Furthermore, power may arrive at the sub-station from more than one source and because of price or availability, it may become necessary to switch from one source to another. When power is interrupted at such high voltage levels, an arc forms between the switch contacts. This can produce temperatures in excess of 4700° C (8500° F). At these temperatures, it does not take long for the metal contact surfaces to melt and fuse. Therefore, it is necessary to quench and cool the arc as rapidly as possible. For many years this was accomplished by the use of oil- lled switches [Figure 1] referred to as "circuit breakers". These switches submerge the contact surfaces in oil, and then when the switch opens, the arc is quenched and cooled by the oil and by the "hydrogen" gas bubble which is formed around the arc. Flammable oil, hydrogen gas, and high arc temperatures create potentially hazardous conditions.Therefore a safer and more reliable method was needed.

In 1956, Westinghouse Corporation develope what is still considered today as the safe alternativ to oil- lled switches [Figure 2]. They did so by placing the switch in a vessel purged with SF_6 (sulphur hexa ouride) gas. SF_6 is a very strong dielectric man-made compound which resists the formation of arcs in high voltage interrupts. As the SF_6 gas-immersed contact surfaces open, a high pressure shot of SF_6 gas is blown into the area, further cooling and blowing out the arc [Figure 3]. SF_6 purged circuit breakers are the most commonly used in the high voltage power industr today, and have been for many years.

As with any other type of equipment, it occasionall becomes necessary to maintain gas- lled breakers. The gas needs to be safely remove stored, ltered, dried and returned to the circuit breaker. This requires special equipment, designe not only to remove the gas, but to compress it an liquefy it, without introducing any air, moisture o other contaminants.

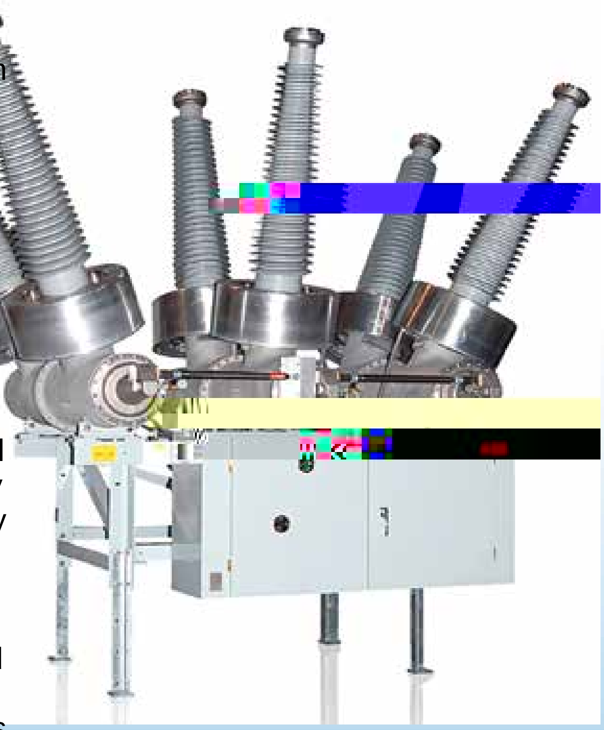

Figure 2 - Typical Sf6 Circuit Breaker

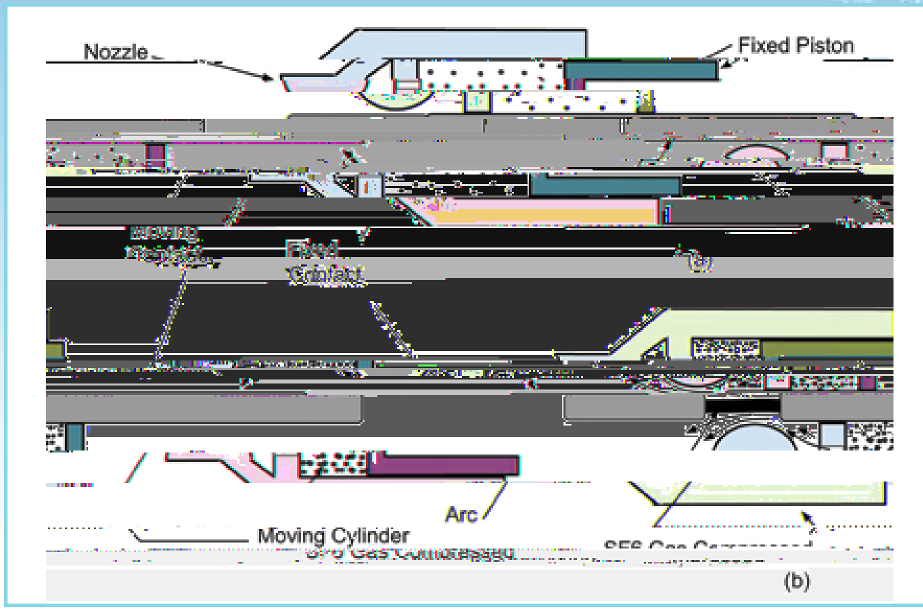

Figure 3 - Puffer Type SF_6 Circuit Breaker

SF_6 gas is a green house gas and is declared to have a global warming potential almost 24,000 times that of CO_2. The National Oceanic and Atmospheric Association (NOAA) has monitored levels of SF_6 gas in the atmosphere since 1995. To date, SF_6 trace gas levels in the atmosphere have increased from 2ppt (parts per trillion) to 8ppt. This increase is driving rules and legislation concerning the inventory, tracking, usage and disposal of SF_6, and is especially relevant as it relates to SF_6 recovery and recycling equipment.

One method of liquefying SF_6 for storage is by "High Pressure Liquefaction", which is accomplished by compressing the gas up to 700 psig then liquefying into cylinders or a vessel. The advantage of this method is that it does not require an oil removal system or refrigeration condensing unit to cool the gas. The disadvantage is that it requires frequent compressor maintenance and retains the inherent problems and dangers associated with higher pressures.

Another method is "Low Pressure Cooled Liquefaction". This employs a more reliable and higher speed oil lubricated compressor, oil removal system, and a refrigerated vessel to store the SF_6. Cryoquip has used this low pressure method in its design and manufacturing of SF_6 recycling equipment since 1984.

In addition to the standard oil removal coalescin Cryoquip also uses an oil absorber filter designed t vapor prior to entering the storage vessel. The compressed SF_6 gas is next chilled and liquefied in the storage vess it will remain until it is needed. When the SF_6 is returned the circuit breaker it will return as a vapor from the t storage vessel. The gas passes through a dryer, b filter, and a fine particle filter, before being returned circuit breaker, thereby removing arc byproducts, moi particle contaminants from the gas.

In order to meet these demands, Cryoquip has added sev enhancements to its SF_6 recovery and recycling equipment. One is a magnetically driven SF_6 vacuum pump capable of recovering gas from a circuit breaker down to 100 mTorr (millitorr) pressure. This, combined with the high speed semi-herme compressor, allows for removal, compression, and liquefact of SF_6 without loss of gas to the atmosphere, and accomplish this at high speed and relatively safe and low pressure.

For further information, visit www.Cryoquip.com

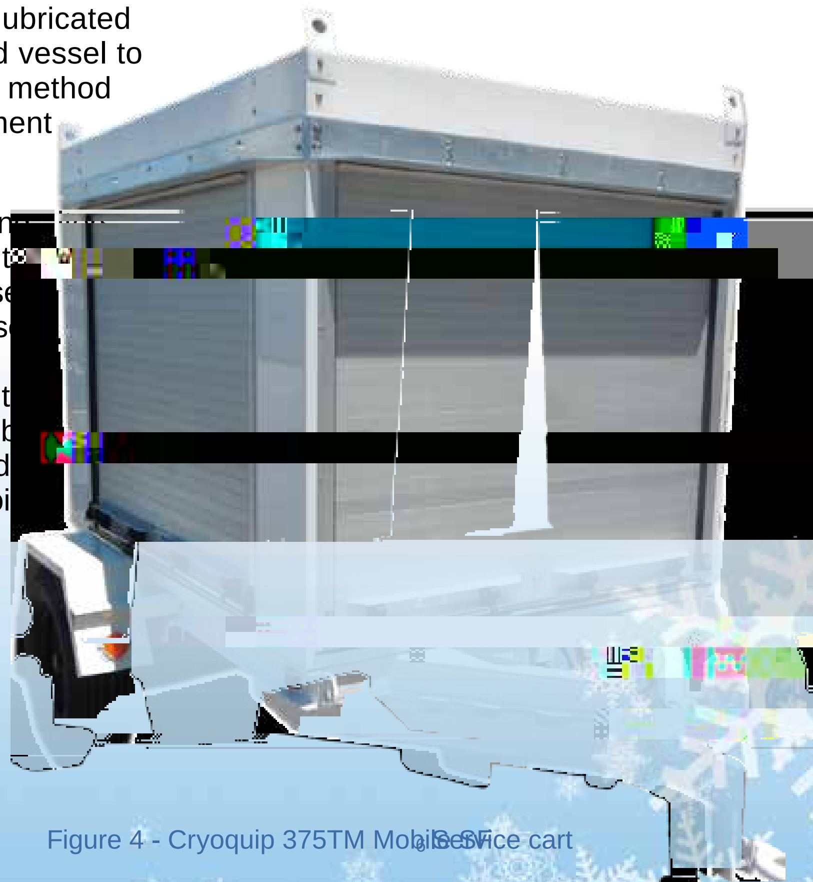

Figure 4 - Cryoquip 375TM Mobile SF_6 Service cart

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