Ambient Air’s Impact on Compressed Air System Performance

By Nitin G. Shanbhag, Senior Manager, Air Technology Group, Hitachi America

Introduction

Ambient air conditions have a significant impact on rotary screw air compressor and refrigerated air dryer performance. Understanding and managing equipment inlet air pressure and temperature, ensuring proper compressor room ventilation, and managing airborne particulates, caustic gases and oil mists, will have a direct impact on the reliability and quality of a compressed air system.

Ambient air pressure and temperature is also known as “Inlet Pressure and Temperature” when referring to air compressors. Decreases in inlet pressure reduce an air compressors ability to produce compressed air. The two most common causes of reduced inlet pressure are higher elevation and restrictive inlet piping or filtration. Increases in ambient air temperature reduce the efficiency of air compressors and air dryers. Managing ambient pressure and temperature helps end users ensure their compressed air systems can efficiently deliver the expected volumes and purity of compressed air.

Most stationary industrial air compressors and dryers are located indoors — inside a factory in a “compressor room.” It’s also common to see them along a wall or tucked into a corner of the factory floor where production is taking place. Proper ventilation and ducting of the “compressor room” is required to maintain inlet air temperatures within design specifications. Compressor room ventilation also provides significant heat recovery opportunities when properly managed.

Ambient air can carry contaminants able to negatively impact the compressed air equipment and the quality of the compressed air. They can reduce compressed air system equipment durability and life and also create production disruptions by impacting production equipment or creating product rejects.

1. Managing Inlet Air Pressure and Temperature To Air Compressors and Dryers

Compressed air is often described as “dynamic” — meaning that the operating characteristics, such as input energy required for specific work, is ever-changing. These changes in operating characteristics are caused by many factors including cooling water temperature, electrical drive train issues, capacity controls, storage, etc. The most overlooked factor, however, is the most significant one — changes in the ambient air surrounding the air compressor.
Lower Inlet Air Pressure: The Effect of Elevation on Air Compressors

The ambient condition of inlet air to the air compressor affects the net weight of the final delivered compressed air to the system. Specifically, inlet temperature, pressure and relative humidity affect both the density and weight of the total compressed air ultimately delivered to the compressed air users in the plant. Keep in mind the following:

- A fixed inlet volume of cold air weighs more than the same volume of warm air
- A fixed inlet volume of air at a higher ambient pressure weighs more than the same volume at a lower ambient pressure
- Water vapor in the inlet air is compressed, discharged and removed by the compressed air drying system and represents a reduction in the weight of air compressed and delivered to the system

Understanding Air Flow Terms: ACFM, SCFM and FAD

Most rotary screw manufacturers describe the volume of air flow their equipment can provide in terms of ACFM and FAD. ACFM stands for Actual Cubic Feet per Minute and represents the actual volume of ambient air that is taken in by the air compressor and delivered to the air system at final discharge pressure. Some companies use the term FAD (free air delivery) instead. This air is taken at whatever temperature, pressure, and relative humidity that exists at the inlet of the air compressor.

This means at inlet conditions, production machine and flow meter manufacturers convert ACFM or FAD into SCFM to correct the flow rate to a standard set of conditions. This corrects (usually lowers) the usable volume to allow for ambient changes
in pressure, temperature and relative humidity. SCFM is calculated on the standard set of inlet conditions of 14.5 psia (1 Bar) ambient inlet pressure, 68 ºF (460+68=528 ºR) ambient temperature, and 0% relative humidity.

**The Effect of Altitude on Sizing Air Compressors — Two Examples**

**Example #1:** A production machine requires 900 scfm of compressed air to function properly. The plant is located in Denver, Colorado, where average ambient air pressure is 12.2 psia. The plant manager understands they cannot assume a “900 scfm” air compressor will provide enough air. Also assumed is an ambient temperature of 90 ºF (460 + 90 = 550 ºR) and 90% relative humidity.

The calculation reduces Denver’s net inlet ambient pressure to 12.2 psia minus .4882 psia, which is the effect of removing the water vapor with the dryer before it goes to the system. This establishes a net inlet pressure of 11.71 psia, not including inlet filter losses.

\[
\text{Acfm} = 900 \text{ scfm} \times \frac{14.5 \text{ psia}}{11.71 \text{ psia}} \times \frac{550 \ ^{°}\text{R}}{528 \ ^{°}\text{R}} = 1161 \text{ acfm}
\]

At this elevation, the production machine needs about 23% more inlet compressed air (1161 acfm versus 900 scfm) to deliver a similar density or weight of compressed air to run the pneumatic process inside the production machine in the example.

**Example #2:** This example comes from a compressed air audit at a pet-food plant, located at a high elevation, in Northern Arizona. The plant had a retort filling process causing significant problems. Retort is a filling process where the product is poured into a container, and then cooked and sterilized inside the container.

When the air compressor and retort process was installed at the plant site, the actual fill time was 11.5 to 12 minutes. The maximum allowable refill rate was 9.5 minutes. This refill rate surprised the plant engineers who had selected the 350 hp, two-

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**Table A: The Approximate Impact of Altitude on Rotary Screw Air Compressors**

<table>
<thead>
<tr>
<th>Altitude Feet</th>
<th>Nominal Atmospheric Pressure psia/Bar</th>
<th>Compression Ratio</th>
<th>Approx. Delivered Capacity acfm/M³ min</th>
<th>Approx % Delivered Capacity scfm</th>
<th>Bhp</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.70 / 1</td>
<td>7.80</td>
<td>1000 / 92.9</td>
<td>100.0</td>
<td>187</td>
</tr>
<tr>
<td>2000</td>
<td>13.66 / .94</td>
<td>8.32</td>
<td>995 / 92.4</td>
<td>93.5</td>
<td>179</td>
</tr>
<tr>
<td>4000</td>
<td>12.68 / .87</td>
<td>8.89</td>
<td>990 / 92.0</td>
<td>87.1</td>
<td>171</td>
</tr>
<tr>
<td>6000</td>
<td>11.77 / .81</td>
<td>9.50</td>
<td>985 / 91.5</td>
<td>81.2</td>
<td>163</td>
</tr>
<tr>
<td>8000</td>
<td>10.91 / .75</td>
<td>10.15</td>
<td>980 / 91.0</td>
<td>75.4</td>
<td>156</td>
</tr>
<tr>
<td>10000</td>
<td>10.10 / .69</td>
<td>10.90</td>
<td>975 / 90.5</td>
<td>69.8</td>
<td>149</td>
</tr>
</tbody>
</table>

As the altitude increases,

1. The actual capacity at intake decreases only slightly
2. The scfm delivered to the system decreases materially
3. The bhp decreases materially.
stage, lubricant-cooled, rotary screw compressor and retort combination — planning a refill rate of 8.5 minutes. A slower refill rate was unacceptable and had a negative impact on production. So what happened when sizing the air compressor?

The answer was the impact of higher elevation. Due to elevation, the air compressor was provided with an actual 11 psia inlet pressure instead of the standard 14.5 psia inlet pressure used when selecting the air compressor. When sizing the air compressor, the refill rate was established at 1820 acfm at 14.5 psia ambient pressure, needing 8.5 minutes to increase pressure from 0 psig to 80 psig with a 350 hp rotary screw compressor. Instead, the result at 11 psia inlet pressure, was 1293 scfm at 100 psig, requiring 385 bhp (405 input hp), and unacceptable refill rates of over 11.5 minutes (adding two minutes per fill).

The lower inlet pressure of 11 psia caused a 25% reduction in the weight of air and the extra energy required to perform the same function was 405 input horsepower for 2 minutes longer per cycle. This resulted in a $79,400/year unanticipated electric energy operating cost at $.10/kWh.

In summary, the lighter the air going into an air compressor, the more ambient air needed to do the same work — such as run an air motor, fill a volume tank, run air cylinders, etc. The higher elevation brings lighter air into the air compressor and higher temperature brings lighter air into the compressor.

Manage Man-Made Causes of Low Inlet Pressure

Most of the time, low inlet pressure is caused by man and not by mother nature. The most common causes of low inlet pressure are avoidable — created by issues with installations and maintenance. Very common issues include restrictive inlet piping, dirty inlet filters, and out of adjustment inlet valves. These immediately have the same effect, as higher elevation, in reducing the inlet pressure to the air compressor.

Example: A compressed air audit, at a foundry, discovered 300 feet of 6" pipe feeding inlet air to three 150 horsepower, lubricant-cooled, rotary screw air compressors (see Figure 1). The inlet piping was very restrictive and reduced inlet pressure from the expected 14.2 psia to 9.5 psia. The impact of this lower inlet pressure was a reduction in available working compressed air from the projected 2,175 scfm to 1,503 scfm. The foundry needed more compressed air and couldn’t understand why the air compressor couldn’t supply enough.

In summary, after the compressor is selected to deliver the proper scfm at site conditions, care must be exercised to not take any actions in installation or maintenance that would lower the inlet pressure and render the compressors too small.

The Impact of Ambient Air Temperature on After-coolers

As ambient air temperature increases, the air’s density is reduced. As ambient air temperature is reduced, the more a unit volume (of air) will weigh, thereby producing greater scfm. In oil-free rotary screw air compressors, the actual swept volume of inlet air has more effect on power draw than does the scfm or weight of air. As the ambient temperature falls, delivered air scfm increases at a much greater rate than the power. The net result leads to a relatively accurate guideline — every 5 ºF of cooling leads to a 1% improvement in specific power or efficiency (scfm/input kW).

Air-cooled air compressors and accessories (particularly after coolers) are used throughout the world. Their performance is directly tied to the ambient air temperature and pressure. As ambient pressure falls, the ability of the cooling air to transfer heat also falls as the air is now at a lower density. When both ambient temperatures are higher and ambient pressures are lower — performance issues become even more significant.

Lubricant-cooled rotary screw or vane compressors inject lubricant (at 150 ºF to 160 ºF) into the compressed air, either at the inlet or immediately after seal-off. The oil acts as a coolant and absorbs most of the heat of compression. Regardless of design, some of this hot coolant/lubricant finds its way back to the inlet, where it can have a significant effect on the temperature of the air entering the rotary compression element(s). This localized heating of the inlet air basically offsets any gain in cooler inlet under normal operating conditions.

Since the ambient air supplies the cooling air to the aftercooler, the
ambient temperature is very critical. At lower ambient pressures, the effective cooling or exchange of heat is reduced further, thus directly reducing performance. This leads to evaluating these situations on a site specific basis.

Most air-cooled aftercoolers have a $\Delta T$ rating of 10 °F to 50 °F - with larger industrial units usually being 15 °F. This means that the maximum cooling air temperature to the air-cooled heat exchanger should be about 85 °F with a 10 °F $\Delta T$.

Extremely high ambient temperatures can shut-down air compressors. Most standard rotary screw compressor packages will have a “not to exceed” maximum ambient temperatures of 104 °F to 115 °F. Special cooling packages are offered to increase the maximum ambient temperatures.

**The Impact of Inlet Air Temperature and Pressure on Refrigerated Air Dryer Sizing**

The correction chart (Table B), used to size refrigerated dryers, shows the effects of inlet temperature and pressure on the flow rating of a refrigerated dryer. Dryer flow ratings are based on the total amount of water vapor that can be held in vapor form for the scfm flow at 100 °F inlet and ambient temperatures. At colder temperatures, the refrigeration capacity can handle higher flows (although excessive pressure loss may be an issue). Hotter air holds more water vapor in vapor form, therefore, as the temperature rises the amount of vapor to be condensed per cubic foot increases — requiring more refrigeration capacity to maintain the required pressure dewpoint. Note that as the inlet temperature rises from 100 °F to 120 °F at 100 psig, the saturated flow rating must be reduced about 32% (.68 multiplier).

Most standard refrigerated dryers can operate under maximum ambient temperatures of 110 °F and maximum inlet temperatures of 120 °F.

In North America, refrigerated air dryers have their flow ratings established by using the “three 100’s.” This is practical only for remembering because it’s not probable to see 100 °F ambient with 100 °F inlet temperatures to a dryer.

### Table B: Refrigerated Air Dryer Correction Factors for Inlet Air Pressure and Temperature

<table>
<thead>
<tr>
<th>Inlet Air Pressure</th>
<th>Inlet Air Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>psig</td>
<td>Bar</td>
</tr>
<tr>
<td>30</td>
<td>3.0</td>
</tr>
<tr>
<td>50</td>
<td>4.4</td>
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<tr>
<td>80</td>
<td>6.5</td>
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<tr>
<td>100</td>
<td>7.9</td>
</tr>
<tr>
<td>125</td>
<td>9.6</td>
</tr>
<tr>
<td>150</td>
<td>11.3</td>
</tr>
<tr>
<td>175</td>
<td>13.0</td>
</tr>
<tr>
<td>200</td>
<td>14.8</td>
</tr>
</tbody>
</table>
In Europe, ISO standard flow rating conditions are a bit more practical setting standard ambient temperature at 77 ºF, inlet temperature at 95 ºF, and pressure at 103 psig (7 bar).

**Example:** Figure 2 shows what occurs when refrigerated air dryers are sized with unrealistic dryer inlet temperatures. As the ambient temperatures climb and the air cooled after-coolers become less efficient, the dryer inlet climbs from 100 ºF to 120 ºF or higher and, in this example, the pressure dewpoint rises from 40 ºF to +77 ºF — basically delivering wet air to the plant air system. It is not uncommon to see refrigerated dryers experiencing 130 ºF inlet air temperatures. This why one often hears, “the dryer works ok except in hot weather!”

### II. Proper Ventilation to Remove Heat from the Compressor Room(s)

Often the actual operating ambient conditions are dictated by the ventilation (or lack there-of) in the compressor room(s) in the plant. The serious issues created by poor ventilation can include negative pressure (low ambient pressure), high ambient temperatures, and the high potential for compressor inlet contamination. These issues are not site-created (like elevation), they are man-made and can always be eliminated. Their negative impact is significant with regards to the energy efficiency and overall system performance.
cost, performance and reliability of the compressed air system.

Figures 3 and 4 show two of the most common forms of compressor room ventilation. These and variants of these will all work. The first step is — what is the total heat load in the compressor room?

- Compressor drive motor
- Fan motor/pump motor
- Dryer heater
- Blower motor
- Refrigeration drive motors
- Variable speed drives
- Other operating equipment

Total horsepower times 2546 btu/hour will provide an approximate estimated btu/hr heat load. Do not use Bhp (compressor shaft) motor nameplate, get actual input horsepower. In most cases, it is suggested the plant utilize the services of a professional HVAC engineer. However, to get a general idea of what is required to ventilate the compressor room (without refrigerated air conditioning) to a certain degree level above the surrounding ambient temperature, use the following:

\[
\text{Cfm cooling air} = \frac{(\text{sensible heat}) \text{ (btu/hr)}}{1.08 (T_1 - T_2 \text{ temperature rise})}
\]

Typical commercial 200 hp class air cooled, lubricant-cooled rotary screw:

\[
\text{Cfm cooling air} = \frac{(230 \text{ hp}) 2546 \text{ btu/hr}}{1.08 \times 10} = 54,220 \text{ cfm}
\]

The cooling fan of a typical 200 hp lubricant-cooled, rotary compressor will probably move about 20,000 cfm (565.23 M3) of cooling air out, leaving an additional high potential required cooling air flow of about 35,000 cfm.

There are variables that may drive this answer somewhat lower (or higher). The main point is when an air-cooled, lubricant-cooled, rotary screw uses ductwork to take the cooling air out of the room, an additional room air exchanger will be required. Water-cooled units will generally reject less heat to the room than air-cooled.

Control Compressor Room Temperatures to between 40 °F (min) and 100 °F (max)
Figure 5 shows improper ducting. Note the ducting on the 200 hp air compressor was restricting the flow of the cooling air out causing a 9 °F rise in inlet temperature over the 95 °F room temperature. The room temperature was 95 °F when the outside ambient temperature was 45 °F (ΔT 50 °F) and three walls of the room were outside. There were two 200 hp compressors with similar installation and one smaller 60 hp trim unit recently added that was ducted correctly.

In order to hold the room temperature higher, very little make-up air was brought into the room. The net result was a significantly negative pressure of 12.2 psia when the outside ambient pressure was 14.3 psia. Basically, the room now seemed to be located in Denver, Colorado. This resulted in an approximately 14% reduction in available compressed air.

In this example, the plant was running all three compressor units 24 hours a day. Modifications were made to the ducting, similar to Figure 3, where heated cooling air was dumped back into the compressor room to keep it warm with thermostatically controlled louvers and the improper ducting was reconfigured. Proper make-up air was allowed back in and the operating ambient pressure returned to 14.2 psia. The 60 hp air compressor was no longer needed, the six months a year of cold weather (4350 hours/year) and the electric power energy savings was (51 kW)($.11/kWh) x 4350 hours/year = $24,400/year. The total project cost was $12,800.

In summary, wherever the compressors are operating, the plant operations personnel should be aware of the actual operating ambient conditions. Are they optimum? Remember, in order to measure psia, a vacuum gauge is needed.

III. Compressor Inlet-Air Contaminants; Solid Particles, Aggressive Vapors/Gases, and Oil Mists

As production machinery and processes continue to evolve, more and more industries are requiring cleaner and drier air for both machinery reliability and product integrity. As line-speeds and productivity continue to accelerate, anything that stops production or significantly slows it down can have very expensive after-effects. Product contamination can lead to expensive scrap levels, and even worse, brand-damaging product recalls.

Airborne Particle Contamination

Airborne particle contamination is usually a very straightforward contaminant that is often ignored. The compressor OEM installs an inlet air filter usually rated for “standard conditions” which most often means 99% removal of all particulate 5 micron and larger and 95% removal of all particulate 3 micron and larger.

Normal life of these elements is expected to be two months to six months. When high dust applications are encountered (such as at corrugator plants, mineral processing), the high-dust levels will usually be quite visible and a high-dust version of the inlet filter is used which normally includes a pre-cleaning area where the heavier dust loads fall out and are removed before they get to the main filter element.

Example: The major (and not so obvious) problem with compressor inlet air is not the visible high dust but when the inlet air ambient area has very small fines (<3 microns smaller) which pass through the standard filters. A good example of this was a plant manufacturing automotive catalytic converters. The process filled the ambient area with a high concentration of very small fines (<3 microns smaller) which pass through the standard filters. These fines passed through the inlet filter and shortened the normal 1-2 year separator life (of a lubricated rotary screw air compressor) to two months. The first attempt to fix this was an oil bath filter which didn’t do a good job because it only wetted the screen properly at high flows — the
compressor was at modulation control with constantly varying flows, and at low loads everything passed through even worse — resulting in as low as a one-month separator life.

The final fix was a high quality, oversized dry filter with an oil wetted pre-filter screen. The screen was kept oil wetted by a pneumatically aspirated oil spray. It was effective in trapping the fines and had to be manually cleaned about once a week. With this, the separator problem went away.

Apart from the obvious damage particulates can do when introduced inside an air compressor, there is the outside fouling or plugging of all air-cooled heat exchangers such as oil/coolant air coolers, air-cooled aftercoolers, electric motor-cooling, and air-cooled condensers on refrigerated air dryers. Many air compressor units are packaged in full sound and ambient controlled enclosures. When this is the case, all incoming cooling air and inlet air to the compressor can be pre-filtered with material and methods appropriate to the identified contaminants before they enters the compressor package (see Figure 8).

The same panel type or air handling room filtration can be applied to total compressor room pre-filtration much as seen now in many laboratory and even powder paint installations. The simplest action of all is to identify the source of the contaminant and either eliminate or move the source, or move the location or area, from the inlet and cooling air source.

Aggressive Caustic or Acidic Vapor That May Become Aggressive Once Inside the Compressor

Aggressive airborne vapors and gases are often overlooked and hard to find. Depending upon the situation, they can do very expensive damage. Some of the more well-known aggressive vapor contaminants (such as fluorides and chlorides) are usually avoided by location as well as such items as cleaning acids, caustics, etc. However, in many cases the compressor room, particularly when well-designed, appears to be very spacious in a crowded plant. Often it becomes a storeroom for various plant supplies. It is not unusual to see such items as water cooler cleaners (usually acid), and water treatment supplies stored in or near the compressor and dryer ambient air.

Example: A soft drink syrup plant was experiencing a great deal of problems with the extremely short life of the food grade lubricant coolant (PAO) of the air compressor. It was found that water treatment chemicals were being stored with open containers right next to the

Exhaust

Air Intake

OSP 37 kW Next Series
compressor. After further investigation, it was determined this to be the basic cause and the plant was warned that there would be an excellent chance that further damage would be incurred to critical internal parts of the air compressor.

Plant personnel did not agree until it was pointed out, that all copper pipe was now green from exposure to the ambient air. Once the chemicals were removed, the problem disappeared.

Plants must also look out for benign vapors that can easily become aggressive once inside the air compressor. Sulfur dioxide (SO\textsubscript{2}) is a very common transient vapor or gas in many plants. The most common sources are wash stations and battery changers. If this gas or vapor enters the air compressor where it becomes concentrated along with the always present water vapor (H\textsubscript{2}O), it can and often does combine into H\textsubscript{2}SO\textsubscript{4} — sulfuric acid — which then attacks internal parts of the compressor such as the aftercooler, drains, dryer, etc and particularly black iron pipe. This is a common enough problem that it bears special attention on a continuing basis.

Evaluating a compressed air system ambient location is very critical to energy efficient operation and operating reliability. This topic is also something that maintenance personnel should address to be ensure continuous awareness.

**Airborne Oil Mist Contamination**

Airborne oil mist contamination is another contaminant often overlooked. If the negative impact on the product integrity and/or operating equipment, particularly air cooled coolers, shows up early it can create a lot of problems unless identified and corrected.

Remember that the contaminant vapor or gas comes in with the air at a certain concentration. As the inlet air and contaminant vapor is compressed to a smaller volume, the concentration of the contaminant is increased.

Hydrocarbons entering through the compressor inlets and migrating through to product contamination (food, paint, etc) can come from many sources including:

- An outside plant wall on a parking lot or roadway with constant automotive exhaust
- Operating forklifts in the area where the engine exhaust is taken into the compressor
- Furnace or other similar exhaust flue air migrating to the compressor area ambient

Obviously this list could go on and on, but what is to be done if you can’t
avoid or eliminate the oil mist after the source is identified?

The quickest and most practical way is to install an appropriate carbon filter, designed to adsorb the identified vapor contaminants after the compressed air dryer and primary filters — problem solved. Depending on the magnitude of risk, you may want to change filters on a predetermined regular basis or install a trace measurement system downstream to alert. Most if not all

**Patented Closed-Loop Gear Case Oil-Mist Removal System**

A patented process exists to eliminate the risk of air compressor sump oil mist being reintrained by the compressor intake. Hitachi oil-free rotary screw air compressors do not vent oil mist to atmosphere. This patented process creates a closed-loop gear case oil mist removal system that recycles the oil to the gear case.

One to three cfm of compressed air is regulated through a venturi. The venturi pulls a vacuum on the gearcase and pulls the oil mist into a coalescing filter. The oil is removed from the bottom of the housing, by a float trap, and returned to the gear case.

1. Oil mist from GC vent is removed almost completely (99.99%)
2. Removed oil is automatically returned to gear case, Reduces need for make up oil
3. Gear case is kept in negative pressure to ensure zero oil migration through seal system.

The Hitachi Patented Closed-Cycle Oil Mist Removal System – U.S. P 05011388.
of these type of filters will not have a physical signal (like measurable change is \( \Delta P \) pressure loss) when the filter is saturated.

Many oil mist ambient contamination problems are easy to observe and correct such as the cylinder exhaust on an automotive fender (Figure 9). Others are much harder to find such as oil mist coming from crankcase and gearbox vents in various compressor drive systems.

Most conventional crankcase gearbox vent systems will have some type of baffle or filter agglomerator to capture and collect the oil mist coming from the case. This amount will vary by drive case pressures. These types of agglomerators will range from relatively crude to very sophisticated but they all rely heavily on mechanical tapping and careful and timely maintenance.

If the oil mist is allowed to become a viable part of the ambient air it will enter the compressor through the inlet, become concentrated and go through the compressors, which, in an oil free compressor there is no oil separation system — and then enter the air system in varying levels of contamination. This could overwhelm a dryer filter system originally designed for oil free discharge air.

A new closed loop, gear case, oil mist recovery system has been introduced to the market, in an oil-free screw compressor, to address and eliminate this issue (see diagram on page 11).

- 99.99\% of the oil mist is reported to be removed from the vent air
- The removed oil is collected and returned to the gear case
- The gear case is kept in negative pressure to allow no outward oil migration
- This unit appears to be much less prone to early fouling and allow excessive crankcase pressure build up

**Conclusion**

Ambient conditions cannot be ignored in order for a compressed air system to deliver high quality, reliable, compressed air in an energy efficient manner.

In reality, there are two ambients to consider:

- Nature — the elevation and general atmospheric condition. The plant has no control of elevation and outside ambient temperature. These conditions are truly dynamic and changing on a continual basis. Plant personnel have to understand them and their impact on equipment performance and efficiency and operate accordingly.
- The internal plant operating ambient conditions can be very hostile. In fact, more hostile than nature. These conditions were created by people and in most cases are correctable.

Understanding and managing equipment inlet air pressure and temperature, ensuring proper compressor room ventilation, and managing airborne particulates, caustic gases and oil mists, will have a direct impact on the reliability and quality of a compressed air system.

For more information, please contact Mr. Nitin G. Shanbhag, Senior Manager, Air Technology Group, Hitachi America, tel: 704-972-9871, email: airtechinfo@hal.hitachi.com, www.hitachi-america.us/ice/atg

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**Hitachi America, Ltd.**  
Air Technology Group  
6901 Northpark Blvd, Suite A  
Charlotte, NC 28216  
Tel: 704.494.3008  
airtechinfo@hal.hitachi.com  
www.hitachi-america.us/ice/atg