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Compressed Air in Aluminum Foundries

Ingersoll Rand®

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Introduction

Aluminum production is an energy-intensive branch of the metal industry encompassing numerous applications, such as binding, crushing, settling, calcination, and smelting - to name a few. A stable and clean compressed air supply is required for these applications because it acts as the main driver, keeping many pieces of equipment up and running. Whether it is recycling or rolling, a dry and clean air environment is paramount to guarantee precision, quality and cost-effectiveness.

Global Aluminum Foundries Market Overview

Significant advancement in computerization and robotics has not missed the aluminum production market. It is paving the way for new innovative technologies and solutions. In fact, increasing demand for metal processing in numerous growing economies is about to boost the global aluminum market, endowing it with lucrative growth.

The global aluminum production market was valued at USD 86.92 billion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 5.0% from 2022 to 2030. Due to its lightweight and high strength, aluminum continues to increase in use in automobiles, and is likely to continue to drive the market in the coming years. Aluminum is also being used more and more in agricultural equipment, construction equipment, mining equipment, and other heavy-duty machinery. With all of this growth and expansion expected, it's important for you and your foundry to stay ahead of competition, which is why an efficient, high-performance compressed air system is of the utmost importance!

In This White Paper, You Will Learn:

- The uses of compressed air in the aluminum industry
- How to achieve consistent, clean, dry air at a steady pressure for your aluminum foundry
- The expert compressed air solutions we have available to you
- How to find service and maintenance programs that optimize the total cost of ownership

Compressed Air in Aluminum Production

Processes used in aluminum production, such as binding, crushing, settling, calcination, smelting would be slow and inefficient by today's standards if not for the power of air compressors, since they are considered the main power source in manufacturing. From precision and pace conveyor belts, to various pneumatic tools that shape, coat and finish various metal products, air compressors keep many pieces of equipment running and performing effectively. Not only does compressed air supply energy more efficiently, but expertly delivered quality compressed air is also more reliable and helps to avoid problems and faults in production processes. Hence, when treated according to the right requirements, air compressors can help aluminum foundries to reduce costs and avoid production standstill.

Applications that Rely on Compressed Air in Aluminum Production

Quality air compressors are an integral part of aluminum foundries. Clean and dry air with a steady pressure is crucial for applications like extrusion, rolling, foundry processes or recycling because any air pressure or moisture fluctuations can cause product quality losses, and consequently, lead to rework and lost time.

When it comes to grinders and other pneumatic tools that need a continuous supply of clean, dry and highly compressed air to operate, low pressure resulting from too many tools added to too few compressed air lines can slow down productivity. Grinding tools also require high intermittent demands which puts an extra strain on the air compressor. It is necessary to deliver a reliable and energy-efficient air supply provided by quality air compressors to keep a steady work pace.

But how do you achieve clean, dry air? The secret is an effective downstream system! For the aluminum production industry, we'd recommend incorporating desiccant dryer into your system, which uses an absorbent material to produce ultra-dry air for your processes. To accompany this, a filtration system and condensate management unit will help eliminate moisture in your system. This is important, as left unmanaged, moisture can have detrimental impacts on the longevity and performance of your grinders and other pneumatic equipment, as well as on your air quality.

Bauxite Mining

Bauxite is the primary raw material used in the manufacture of aluminum. In fact, extracting 1 ton of pure alumina requires approximately 4-5 tons of bauxite. Drills, conveying systems, and other pneumatic tools are commonly powered by compressed air during exploration and extraction. They provide clean, breathing air, remove water and moisture, as well as safely move and handle materials around the site. As mentioned above, an effective downstream system will be imperative for this application, as efficient bauxite mining relies on powerful pneumatic tools and clean, dry air!

Bauxite Grinding

Bauxite mineral is transported to refineries where clay from the mine is washed off. The bauxite passes through a grinder to produce a more consistent material. This process requires high intermittent air demands, putting extra strain on the air compressor. In order to keep a steady work pace, it is necessary to provide a reliable and energy-efficient air supply with the right air quality to protect the equipment. Unsure whether your equipment is up to the job? To quantify your exact air flow, pressure and quality demands, we'd recommend an air audit, which conducts a thorough analysis of your existing system. From here, improvements and enhancements can be made, or a completely bespoke system can be designed and built to better align with your exact aluminum production demands.

Bauxite Crushing and Digesting - Producing Sodium Aluminate

The mined mineral is then pumped into large pressure tanks with a caustic soda or sodium hydroxide solution. When steam heat is applied, the caustic soda reacts with the aluminum compounds in the bauxite material to produce a solution of sodium aluminate (also known as slurry). The unwanted residue (also known as red mud), containing iron, silicon and titanium, gradually sinks to the bottom of the tank and is removed. The process requires a steady supply of dry and clean air to move the contents and avoid contamination. Therefore an effective downstream system will also be vital here to maximize the quality and usability of your compressed air!

Settling and Precipitation

Both settling and precipitation processes need high volume and good quality air, making it vital that your compressed air system is up to the task! Here, the sodium aluminate solution is pushed into lower pressure settling tanks. The solution at the top of the tank is directed downwards through a series of filters to remove excess red mud. The remaining alumina is then passed through huge "leaves" or cloth filters to remove any solids in the solution.

The sodium aluminate solution is then cooled and pumped into large precipitators (sometimes as tall as a 6-story building). Aluminum hydroxide seed crystals are added to the solution to start the precipitation process. At this point, large aluminum crystals are formed.

Calcination and Smelting Process

Following the settling and precipitation processes, the aluminum crystals are heated in rotary kilns to temperatures over 960°C. This extracts the last impurities and creates a white powder known as alumina or aluminum oxide. The refined alumina is transformed into aluminum through the smelting process, where it is poured into a reduction cell with molten cryolite at 950°C. 400kA electrical currents are passed through the mixture to break the bond between the aluminum and oxygen. The result is 99.8% pure aluminum. Compressed air is an indispensable utility to achieve the best performance as it is used for instrumentation (high-quality compressed air), agitation (very clean compressed air to avoid contamination) and cooling (high.volume compressed air). Again, this means that a reliable downstream system to remove impurities and produce ultra-dry air in high volumes is imperative to your aluminum production processes. Without it, you risk low-quality aluminum and unexpected downtime due to equipment inefficiencies!

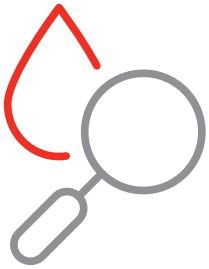
Removing the Pain Points

How To Achieve Consistent, Clean, Dry Air At A Steady Pressure For Your Aluminum Foundry

As mentioned, achieving clean air that is at a steady pressure is essential at every step of your aluminum processing. But how can you ensure that your compressed air system is fit for the challenge?

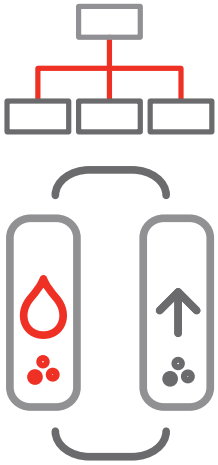
1. AIR AUDIT

The best place to start is with a thorough compressed air system audit, which analyzes how your existing system is standing up to your requirements. This service will provide valuable insights into any areas of inefficiency, or potential improvement, as well as detecting any leaks or other problems. After this in-depth analysis, enhancements can be made to your existing system, or we can design and build you an entirely bespoke compressed air solution that is tailored exactly to your needs. This will enable your operations to be more efficient, as all air quality and pressure demands can be better met. We'd recommend air audits particularly for foundries that power a lot of pneumatic tools, as these have very specific pressure and air flow demands!



2. OIL SAMPLING

Another assessment available to help ensure air quality, is oil sampling! This service provides you with a comprehensive report about any internal or external contamination that may impact your compressed air system. It also assesses the inner workings of your compressed air system, and its ambient conditions allowing you insight into factors that may affect the quality of the oil and lubricant of your system. This will also give you an overview of the condition of all of your compressor's components. Identifying these issues is vital to ensure that changes can be made, before your operations suffer due to substandard air quality. It also means that a proactive, predictive maintenance plan can be designed based on the typical degradation period of your oil. Frequent changing of the lubricant in your system is essential to prevent equipment damage which could lead to safety breaches. It's also important to ensure you can produce consistent Class 0 ISO air for your aluminum processing applications. This is particularly important for powering pneumatic equipment and for the settling and precipitation processes, as high-quality air is non-negotiable!

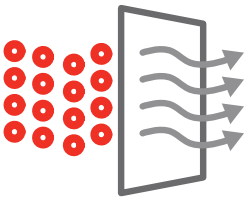


3. A DOWNSTREAM SYSTEM YOU CAN RELY ON

Due to all aluminum processing applications requiring clean, dry air at a steady pressure, an effective and reliable downstream system is vital! This consists of 3 key components.

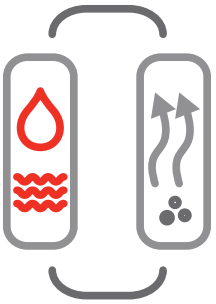
Dryers:

The first key component are compressed air dryers, whose job it is to eliminate moisture from your system. As mentioned, this is essential for powering pneumatic tools, as moisture can lead to equipment degradation, and low-quality air. There is a wide variety of dryers on the market, including desiccant systems, which use an absorbent material to produce ultra-dry, high-quality air at a lower pressure dew point. There are also refrigerant dryers which are better suited for general applications, and heat of compression dryers, which are ideal if you wanted to utilize wasted compression heat. For use in aluminum foundries, we'd typically recommend desiccant dryers, as they are ideal for powering pneumatic and heavy machinery due to their effectiveness at removing moisture and producing ultra-dry air!



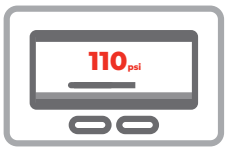
Filtration System:

An effective, reliable filtration system is also of fundamental importance in air treatment, as it helps to remove contaminants and impurities such as oil, dust and moisture. This is essential to ensure the production of clean, ISO standards air for your processes! By implementing a filtration system, you can ensure that your air is consistently clean and dry for your aluminum processing applications.



Condensate Management & Treatment:

No downstream system is complete without a condensate management and treatment unit! This is essential, as condensate is a natural by-product of compressing air. The most effective way to deal with condensate is by implementing a condensate management unit, which often contains zero-loss drains. These condensate or zero-loss drains transport your air into an oil water separator, where the condensate is removed. An oil water separator is a fundamental part of effective condensate management because it ensures that it is properly disposed of in a way that adheres to strict industry regulations.



4. MONITORING & MANAGEMENT SOLUTIONS

Another way to ensure your air quality and pressure meets your application requirements is through effectively managing and monitoring your compressed air system. This can be done with a compressor controller, which will allow you to adjust flow rates and pressure to prevent inefficiency, and make sure that your air is meeting your exact requirements. Due to the nature of the applications within the aluminum processing industry, monitoring the pressure and flow of your air is vital to ensure your operations can run smoothly, and without any unexpected issues. At Ingersoll Rand, we also offer our 24/7 remote monitoring Helix™ Connected Platform. This is discussed in more detail in the Service and Maintenance part of this Whitepaper. Our IIoT monitoring solution is another way you can manage your system and monitor the quality of your compressed air!

5. HEAT RECOVERY SYSTEMS

Not necessarily to ensure air quality, but more to do with the efficiency of your aluminum foundry, is the potential for a heat recovery system. Heat is a natural by-product of compressing air, but did you know that 90% of the wasted heat can actually be recovered and used? By implementing a reliable, high-performance heat recovery system into your facility, you can save 1000s of dollars a year whilst also maximizing your efficiency and reducing your carbon footprint. The heat that this system collects can be used for a variety of applications, including heating process water, and your facility.

6. WARRANTIES, OEM PARTS & MAINTENANCE

Understanding the warranties, OEM parts and accessories, and maintenance plans available to you is vital to ensure your facility is always operating at its best, with the best quality of compressed air. For example, at Ingersoll Rand we offer a comprehensive suite of CARE maintenance plans to protect you and your compressed air investment! Whether you need scheduled predictive maintenance, a warranty, OEM parts and accessories, total asset management or remote monitoring, Ingersoll Rand ensures you are receiving the exact service you need! Correctly managing and maintaining your compressed air system is essential to maximizing the efficiency of your facility, and to ensure optimal air quality!

Find a Partner You Can Trust

Ingersoll Rand has been working closely with aluminum foundries to provide clean, reliable, and energy-efficient solutions that perfectly match the needs of aluminum producers.

Size Your Air Needs - Our Compressed Air Solutions

Ingersoll Rand's compressed air solutions for aluminum foundries will keep your business operating at full capacity. We offer a wide portfolio of innovative air products, services and solutions that enhance energy efficiency and productivity objectives.

Reciprocating Air Compressors

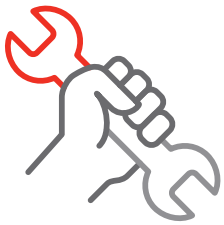
Ingersoll Rand offers single-and two-stage reciprocating compressors that are ideal for applications that demand a reliable air supply for everyday use. Their durable, reliable and compact design gives users the flexibility to use them anywhere they are needed.

Rotary Screw Compressor

Every component in our oil-flooded compressor system supports maximum reliability for increased productivity, longer equipment life, lower operating costs and higher profitability. Advanced airend and drive component designs provide world-class specific power and best-in-class air flow, resulting in reduced energy use.

On-site Nitrogen Generators

Ingersoll Rand's on-site nitrogen generators offer quality and reliability so that you can focus on maximizing the productivity of your operations. Our efficient designs generate nitrogen from freely available air that allows you to forgo traditional nitrogen delivery and simplify your business processes. Combined with our line of complementary products, you can enjoy peace of mind, knowing that your entire nitrogen production process is backed by a trusted partner from start to finish.



Service and Maintenance Programs

There are many applications in which you will require high-quality compressed air in your plant. You also now understand how to achieve consistent, dry air at a steady pressure for your aluminum foundry. Now it's time to look at how to service and maintain your equipment to avoid unplanned, unbudgeted downtime and production interruptions.

Lower cost of ownership, quality results, increased uptime, and efficient energy use all add up to peace of mind.

PackageCARE™: We Protect You

- The greatest value for asset management
- Transfer operational risk for up to 10 years
- Includes all scheduled maintenance
- Predictive and analytical tools prevent production interruptions

PlannedCARE™: We Help You

- Predictive, on-time planned maintenance
- Preventative diagnostics to catch potential problems
- Up to five-year coverage on major airend components in new rotary compressors

Performance Services

Our performance services include electronic, air leak, and system assessments. Whether you need to manage costs, increase reliability, or plan for future growth, our portfolio of assessment tools provides you with detailed diagnostics that give you the proper insights to help lower the total cost of ownership.

System Automation

System assessments often identify waste caused by a lack of adequate controls. Our suite of automation solutions lowers energy costs and stability pressure.

HELIX™

24/7 Remote Monitoring With The Helix™ Connected Platform

Developed to maximize uptime and peace of mind, the Helix™ Connected Platform from Ingersoll Rand gives you real-time monitoring that provides visibility into machine functionality and equips you to operate at maximum efficiency. Your team will have direct access anytime to Helix™ insights and diagnostic reporting that can help prevent lost productivity from unforeseen breakdowns. Maintenance scheduling is simplified thanks to proactive service reminders and automated communications that help to preserve machine health.

There's a lot riding on the quality of your air. Let Ingersoll Rand help you get it right!

Reliability for Life

Generate air in any environment. We offer solutions that operate indoors and outdoors in compact spaces and extreme temperatures.

- Enjoy increased oversight with controls you can access remotely. Regulate your air use with compressor controls that monitor critical operating parameters and adapt the system to prevent downtime.
- Designed for easy serviceability and maintenance, our compressors minimize the total cost of ownership.
- An extensive catalogue of OEM genuine consumable and replacement parts are available to you to make service and maintenance easy and cost-effective. Genuine OEM parts guarantee a perfect fit and function to the highest quality standards.

PartsCARE™

Protect Your Investment with Ongoing Preventive Maintenance

When it comes to the aluminum foundries, original equipment manufacturer (OEM) parts are an operator's best choice to maintain maximum reliability and performance. Non-standard parts can expose equipment to unnecessary wear and tear, leading to downtime and higher operating costs.

If you want to protect your investment and the performance and longevity of your equipment, make sure to invest in quality parts to keep it running. Ingersoll Rand has a complete offering of maintenance and OEM-quality compressor parts, including lubricants, maintenance kits, replacement parts, filtration and condensation management, complimented by the expertise to keep your foundry running.

Please visit and partner with us!

About Ingersoll Rand Inc.

Ingersoll Rand Inc. (NYSE:IR), driven by an entrepreneurial spirit and ownership mindset, is dedicated to helping make life better for our employees, customers and communities. Customers lean on us for our technology-driven excellence in mission-critical flow creation and industrial solutions across 40+ respected brands where our products and services excel in the most complex and harsh conditions. Our employees develop customers for life through their daily commitment to expertise, productivity and efficiency. For more information, visit irco.com

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Ingersoll Rand compressors are not designed, intended or approved for breathing air applications. Ingersoll Rand does not approve specialized equipment for breathing air applications and assumes no responsibility or liability for compressors used for breathing air service.

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