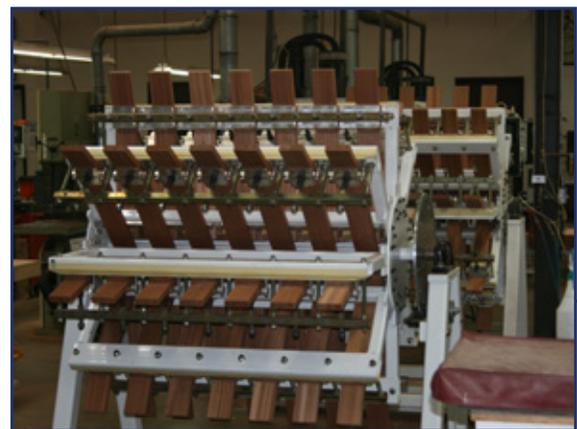


KEY FACTORS IN HUMIDIFICATION

“... koolfog allows for precise humidity control throughout a facility, in different applications and environments...” //

Humidification in Manufacturing

Humidification is an essential part of manufacturing and storage for a variety of manufactured goods. Lack of consistent and accurate humidity during the manufacturing process can lead to inefficiencies as well as quality concerns with final goods. Also, if the stored goods are not kept at proper humidity levels, they can deteriorate or be irreversibly damaged. Humidity levels are very specific to different types of materials and can change with weather. That’s why it’s important to invest in a high-quality humidification system that can adjust with changing environmental conditions. Excessive moisture levels, either too high or too low can damage inventory, materials, equipment or even facilities. A humidification solution must also be scalable to allow for changing processes and growth.



How It Works

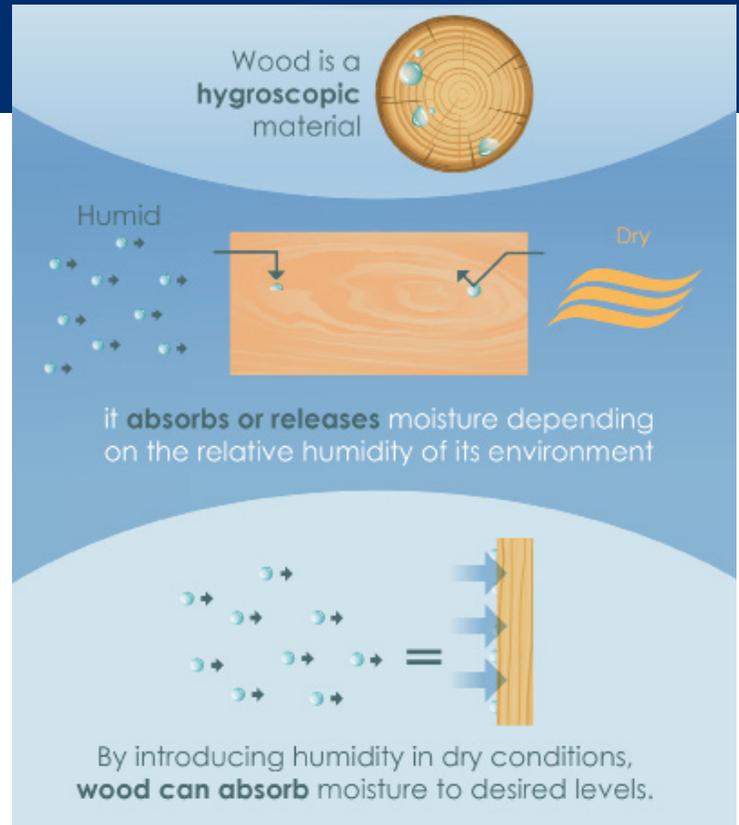
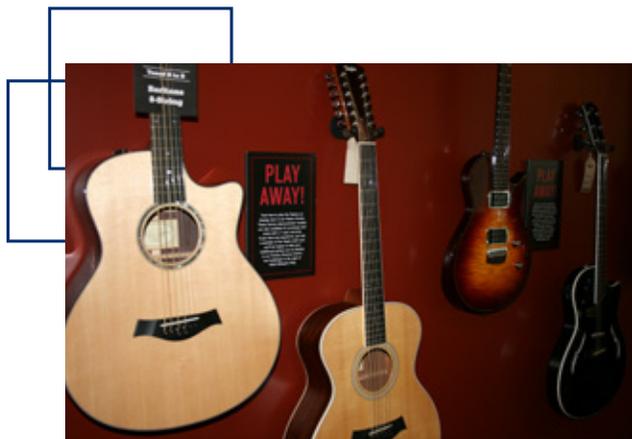
Koolfog humidification systems alter the relative humidity in small and large-scale environments. The process is this. Our systems emit a fog with micron-sized droplets that are perfect for evaporation. These droplets flash evaporate before they hit ground level, which means that the products and processes remain dry while the relative humidity is adjusted to a desired set point. With the ability to section a system off into multiple zones, Koolfog allows for precise humidity control throughout a facility, in different applications and environments. A Koolfog humidification system can also integrate to facility management systems, industrial control systems, greenhouse control systems, weather stations or other outside systems capable of providing outputs to Koolfog’s open control scheme.



Wood Products

Manufacturing and storing wood products crosses many industries. From tables to toys, there are many products that we use on a daily basis are constructed of wood. Annual revenue from the Wood Product Manufacturing Industry is approximately \$7 billion, making it a significant contributor to the overall economy. The industry is expected to increase at an annual rate of 1.4% over the next 10 years. Over the past five years, consumer spending on wood products has increased, according to IBISWorld. This means that the manufacturing and consequent storage of wood products is becoming more prevalent in the global economy.

Wood can be challenging to manufacture and store due to its cellulose nature. Wood is a hygroscopic material, meaning it absorbs or releases moisture depending on the relative humidity of its environment. When the air is humid, wood absorbs moisture, and when it is dry, wood loses moisture. Therefore, maintaining the proper moisture content (MC) of the wood depends on predictable humidity levels in the environment. But this can be difficult to achieve in typical storerooms or storage areas, which are often cold and dry in the winter and too hot in the summer. In fact, during two-thirds of the year, weather and humidity conditions are not conducive to wood maintenance. A Koolfog humidification system can turn those factors around and make manufacturing and storing wood products possible.



Taylor Guitars

If you play a guitar you are aware of the Taylor brand. Established in 1974, Taylor Guitars (<http://www.taylorguitars.com/>) has evolved into one of the world's leading manufacturers of premium acoustic, acoustic/electric and electric guitars. Headquartered in El Cajon, California, Taylor Guitars employs nearly 700 people and currently produces hundreds of guitars per day in its state-of-the-art factory complexes in both El Cajon and in Tecate, Mexico. Renowned for blending an innovative use of modern technology with a master craftsman's attention to detail, Taylor guitars are widely considered the best sounding and easiest to play in the world. As such a profitable and popular brand, Taylor has to make sure that every guitar that leaves the facility is perfect. Koolfog is integrated to building management systems that control the output of the humidification system to maintain a precisely controlled environment for raw and finished wood components. Our system allows Taylor manufacturing plants to make sure that every guitar is produced in a precise and perfected way so that there is no variance in the products. Each Taylor guitar is made in a properly humidified atmosphere that ensures no warping, shrinking, or breaking of the wood.

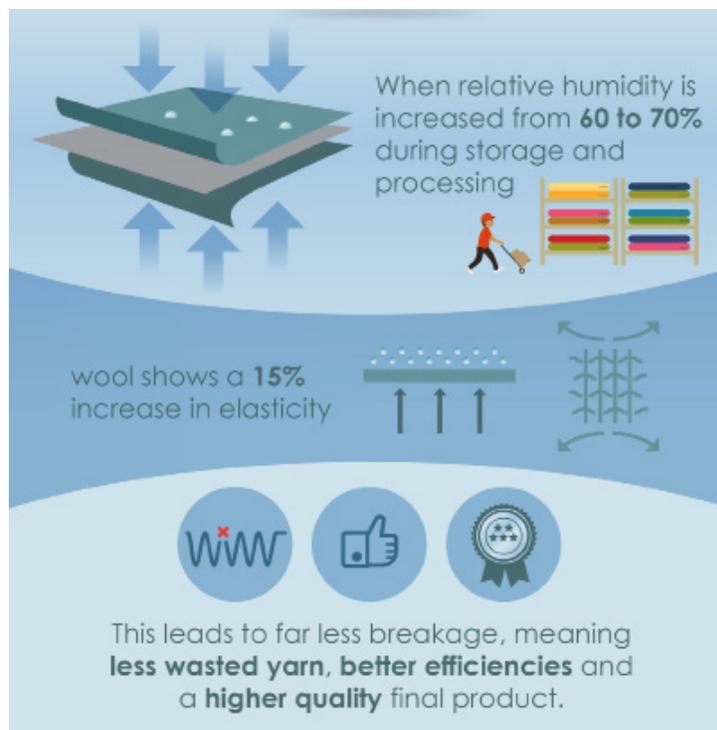
Textiles

The global textile industry is a huge part of the world economy. Imports and exports of textiles increase each year and show no signs of slowing down as consumer demand for clothing and other apparel continues to grow. Cotton and wool tend to be the most exported textiles, but yarns, fabrics and apparel are also notable. Even developing countries have multi-million-dollar textile industries and the factories where textiles are produced provide critical jobs to the communities they are in. In 2016, the United States alone shipped out \$74.4 billion worth of fiber and filament, textiles and apparel.

The production and storage of textiles is an area where humidification is critical. The atmospheric conditions in factories, specifically temperature and humidity, are important during the manufacturing of textile yarns and fabrics. Properties such as dimensions, weight, tensile strength, elasticity and rigidity are all influenced by these factors. For example, the strength of viscose is reduced when relative humidity goes up, as well as generation of static electricity across all textiles when humidity is low.



Factories without air-conditioning or a humidification system often find that they encounter production difficulties when embroidering, weaving and spinning yarn. This is due to breakage and high-static electricity levels that occur when the relative humidity is not optimal. When relative humidity is increased from 60 to 70% during storage and processing, wool shows a 15% increase in elasticity. This leads to far less breakage, meaning less wasted yarn, better efficiencies and a higher quality final product. Preventing moisture loss during processing and storage also reduces weight loss from 4% to .5% in textile products. When factories are consistently seeing a lower quality product or weight loss due to less than optimal humidification conditions, margins can fall significantly. Koolfog humidification systems alter the relative humidity in small and large-scale textile environments..



Paper Manufacturing

Paper is made of cellulose, meaning that it is hygroscopic. As such, it is vulnerable to changes in humidity and temperature. As paper attempts to reach equilibrium with its environment, it collects and releases moisture in accordance with the relative humidity of the surrounding air. Due to environmental changes in manufacturing, storage and handling, many properties of the product can be affected such as flatness, dimensions, strength and performance. The humidity level during these processes must be exactly perfect, as too low RH can lead to brittle products prone to breakage and too high RH means a wet or soggy material. For example, low humidity causes paper to shrink, curl and lose stability, which means costly setbacks and re-production. In an ideal state, the environment is such that the paper neither loses or absorbs moisture from the air. However, this ideal state can be almost impossible to achieve without the assistance of a humidification system, which keeps the moisture level in the air at an exact, desirable level. The ideal humidity level for efficient and effective processing is between 50% - 60%, a level that is achievable with the aid of a humidification system.

A humidification system can also help with the loose particles that are created during paper manufacturing and printing. When these particles are left to float in the air, they can be inhaled by employees or clog machinery. This leads to reduced output, at a minimum, but can present issues meeting regulatory standards set by organizations such as OSHA and other agencies across the globe. The water particles created during humidification can help trap these dangerous particles and remove them safely from the air. Thus, a humidification system is beneficial both in terms of improving product quality and maintaining a safe and productive work environment.

HUMIDITY LEVELS AND PAPER

As paper attempts to reach **equilibrium** with its environment, it **collects and releases moisture** in accordance with the relative humidity of the surrounding air.

However, during this variable process, many properties of the product can be affected such as flatness, dimensions, strength and performance.

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The infographic is a vertical layout with a blue background. At the top, a white speech bubble contains the title 'HUMIDITY LEVELS AND PAPER'. Below the title, there are several icons: a wavy line representing moisture, a paper roll with arrows indicating moisture exchange, and a paper roll with arrows indicating moisture exchange. The text is arranged in three main sections, each with a corresponding icon. The bottom section features a magnifying glass icon over a paper roll, symbolizing the need for perfect humidity. The koolfog logo and website URL are at the bottom.

Cold Storage

As agricultural and livestock production continues to increase globally, new strategies must be implemented to store food before it is brought to market. According to the United States Department of Agriculture in 2018, nearly all frozen and refrigerated food stocks were up from a year ago. Consumers continue to demand a wide variety of frozen and fresh products, from poultry to pecans. In the United States alone, there are over 800 commercial and public warehouses that store refrigerated products. All frozen and refrigerated food must be held somewhere before it can be put on trucks and brought to local communities. Thus, cold storage is a critical part of the food processing cycle.

Maintaining optimal relative humidity in cold storage is essential to ensuring longevity of food products. Many food products, especially produce, require higher humidity levels while in storage or they suffer from a loss of water volume. Water loss directly affects the bottom line, reducing overall weight and often resulting in a loss of quality through wilting, shriveling and/or changes in texture. In this way, storage facilities lose out on valuable profits. A humidification system allows for total control over the moisture levels in the cold storage facility and can help ensure efficient and profitable storage.



Koolfog Headquarters

(760) 321-9203

31290 Plantation Drive

Thousand Palms, California 92276

MANAGING HUMIDITY IN PRODUCE STORAGE

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