

# MANAGING AIR CONDITIONS IN SPRAY DRYING AND FLUID BED SYSTEMS

**COTES**

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In industry, there are massive advantages to be had from removing water from fluid products.

These can include dramatic savings in weight, improved product characteristics and prolonged shelf life – and loads of other practical benefits and operating cost reductions, too.

In many contexts, spray drying is a supremely effective way to do this. But it has the big downside of often providing inconsistent results that fluctuate depending on climate, season and weather, as well as requiring substantial energy inputs.

Less-than-perfect control over processing conditions, while running up big energy bills, is never a good recipe for commercial prosperity – or even for efficiency tweaks.

And that's where modern humidity management comes in ...



# CONTENTS

## MANAGING AIR CONDITIONS IN SPRAY DRYING

1/ HUMIDITY AND SPRAY DRYING .....	09
2/ BIG PERSPECTIVES, BIG OPPORTUNITIES .....	15
3/ ALL A QUESTION OF KNOW-HOW .....	31
4/ COTES DEHUMIDIFICATION SYSTEMS .....	49
RESUMÉ OF BENEFITS .....	56



## 1/ HUMIDITY AND SPRAY DRYING

# HUMIDITY – THE INVISIBLE ELEMENT

### SPRAY DRYING

- > Turns bulky, difficult-to-handle liquids into easy-to-handle, free-flowing solids
- > Removes the relatively heavy liquid component from countless different products, paving the way to big reductions in both weight and volume and therefore in transport, handling and storage costs
- > Makes it possible to maintain control of average particle size, ensuring specification compliance and product consistency
- > Plays a big role in avoiding bacteria growth and improving product quality
- > Makes products much easier to preserve and store, with longer shelf life and better profit margins.

### Important but invisible

The levels of humidity in the air are one of the most important factors affecting both drying efficiency and energy costs in modern spray drying processes.

But humidity is something you can't see – so it's frequently overlooked and its effects are usually under-rated. And dealing with humidity issues often gets left out from mainstream thinking in the world of spray drying.

This is something Cotes humidity management experts aim to change.

### Prevention – always better than cure

The basic point is that it's much quicker, easier and cheaper to prevent difficulties arising than to have to deal with them once they've started nibbling away at your operating margins.

The relative humidity of the air also has a big influence on many other important operating parameters. And that's why dealing with this invisible element effectively can work wonders with product quality as well as your production costs and uptime track record.

### Controlling what's happening

Managing the humidity in the air is by far the most cost-effective way to tackle many of the practical challenges and operating inefficiencies in spray drying operations, and to gain better control of the basic conditions for the drying process.

Modern humidity management using adsorption dehumidification systems is a well-documented, tried-and-tested technology whose cost-effectiveness leaves traditional approaches in the dust.

And Cotes provides a unique energy exploitation set-up (patent pending\*) that will boost your payoffs even more.

### The energy dividend

This is because special Cotes configurations enable you to significantly reduce energy costs by recovering valuable thermal energy from your spray dryer to power the adsorption dehumidification system.

Making sure the flow of air has greater drying capacity is the kind of measure that gets you ahead of the competition on production and processing costs.

\*Cotes A/S has applied for worldwide patent no. PCT/EP2011/001072

## MULTIPLE BENEFITS

CONSISTENT  
YEAR-ROUND  
PRODUCT QUALITY

# 35%

UP TO 35% MORE  
THROUGHPUT

# 15%

REDUCTION  
IN OPERATING  
COSTS

# 35%

MORE DRYING  
CAPACITY FOR ANY  
GIVEN AIR FLOW

GREATER  
RELIABILITY AND  
LESS DOWNTIME

RAPID  
RETURN  
ON INVESTMENT

Cotes provides humidity management technology and expertise that help companies using spray drying to achieve significant operating benefits on three different fronts.

- > Eliminating fluctuations in air specifications, thus reducing product inconsistencies
- > Greater throughput for any given spray drying installation
- > Savings on energy bills.

The key lies in effectively managing the levels of moisture in the air entering the spray drying installation.

### Forget fluctuations

Cotes dehumidification systems enable you to deal effectively with fluctuations in air specifications due to climate, season and weather.

Gaining full control over the levels of moisture in the air at any given time enables you to make sure of consistent operating conditions for your spray drying installation, as well as ensuring consistent product quality and specifications.

### Boost capacity

Unique Cotes expertise about the technical details of dehumidification and using this lesser-known technology in spray drying processes makes it possible for you to achieve the best possible results.

Calculations have shown that Cotes dehumidification systems are capable of boosting throughput in spray drying installations by as much as 35%.

### Save on energy

Cotes technology enables you to run our dehumidification systems using surplus or waste thermal inputs from other machinery or other processes.

This means this energy is pretty much free of charge, helping you roll back operating costs by as much as 15%.

*All figures are approximate, and will normally vary according to details in each particular installation.*

# A PROCESS IN BIG DEMAND

## Inputs and outputs

Spray drying is basically a straightforward process in which hot air is used to evaporate the water content of a fluid, leaving behind a powder that contains the “valuable” solid components.

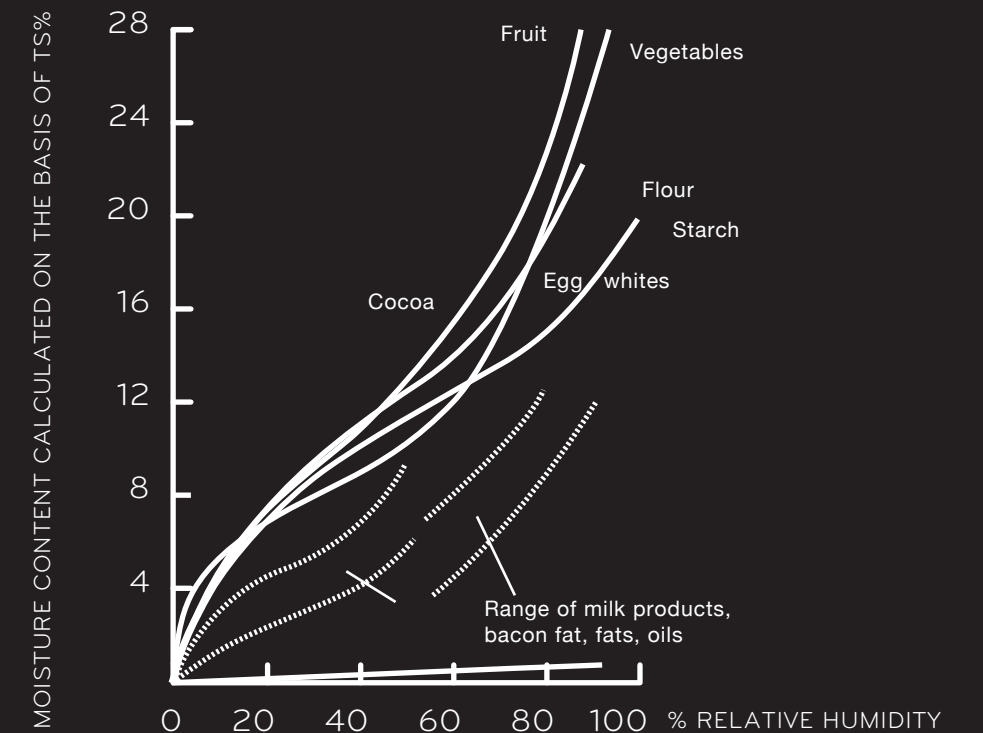
In practice, spray drying is a technically demanding, energy-intensive process that companies use anyway – because the pay-offs are so big.

## Ideal for heat-sensitive materials

Spray drying is extensively used for drying heat-sensitive materials in many different industries.

- > Beverages – coffee, tea, cocoa, juice/soft drink concentrates, etc.
- > Food products – eggs, milk powders, whey, soya, cheese powders, spices, yeast, flavourings, additives, etc.
- > Pharmaceuticals – penicillin, antibiotics, medical ingredients, enzymes, vaccines, hormones, etc.
- > Industrial products – pigments, ceramic materials, pesticides, fertilisers, aluminium and iron oxides, etc.

FIGURE 01  
RANGE OF SORPTION ISOTHERMS  
OF VARIOUS FOODS AT ROOM TEMPERATURE



## Quickly does it

Spray dryers dry a product exceptionally quickly compared to other methods of drying.

They also turn a solution or slurry into a dried powder in one single step, making the whole process much more straightforward and manageable – and with big benefits for profit margins.

## Energy-intensive

With energy costs constantly on the increase, and accelerating consumer demand for dried products with ever-better quality, those responsible for spray drying installations have to keep a watchful eye open for the latest developments in other related technologies that can improve the cost-effectiveness of industrial spray drying.

## 2/ BIG PERSPECTIVES, BIG OPPORTUNITIES

# DRYING REQUIRES ENERGY – BIG TIME

### Applying energy indirectly

The vast majority of industrial drying applications involve removing water. Virtually all the normal ways of doing this involve applying energy at the boundary of the product or material being dried.

This means the energy must then diffuse into the solid particles – mainly by conduction. The liquid must travel to the boundary of the material before it is transported away by the carrier gas (or, in the case of non-convective dryers, by using a vacuum).

### Always energy-intensive

Heating the drying air in order to create a low relative humidity – and sufficient drying capacity – usually involves convection, conduction or radiation. Or combinations of these.

These kinds of thermal drying processes always require big inputs of energy – a commodity that's not likely to become any cheaper or easier to get in the foreseeable future.



# THE BIGGER ENERGY PICTURE

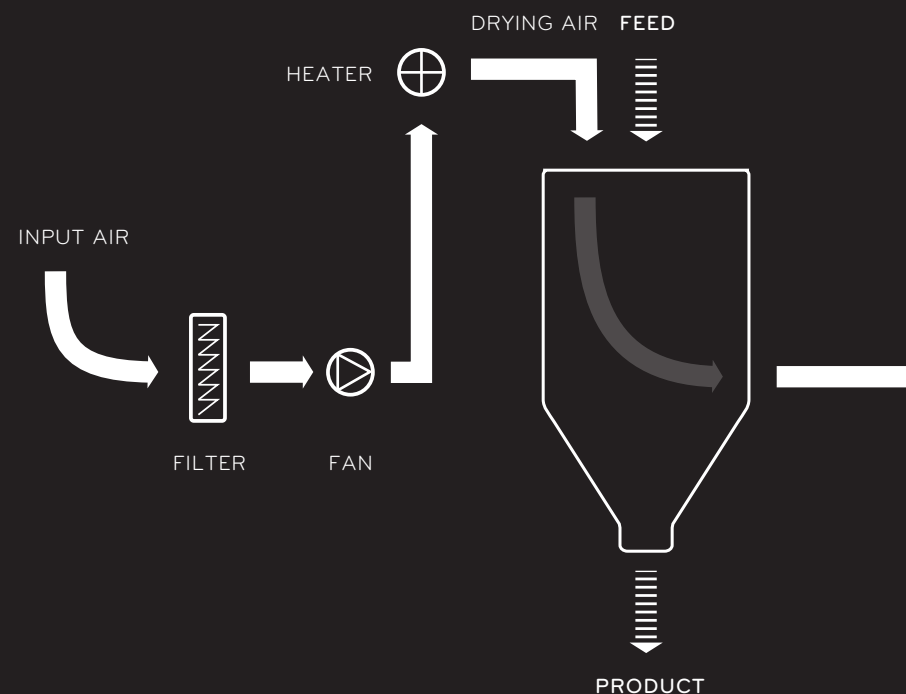
## The bigger energy picture

Compared with traditional approaches such as ice water condensation systems, the use of adsorption dehumidification to boost the effectiveness of spray drying makes good sense both in regard to thermodynamics and cost of energy – only adding energy to help increase temperatures.

Where the temperature in adsorption dehumidification is basically going the right way (increasing), the temperature of ice water condensation systems is going the wrong way (decreasing), and thus needs to be heated again afterwards.

And there's the added advantage that in many plants there may well be substantial quantities of steam available. This is ideal as a cost-effective source of energy for running adsorption dehumidifiers, compared to the often-expensive electricity required to run condensation systems.

FIGURE 02  
TRADITIONAL SPRAY DRYING SET-UP



## In and out

Because both spray drying and fluid bed drying are energy-intensive and depend so much on the intrinsic efficiency of thermodynamic energy transfer processes, the specifications of the air being heated have a big influence on drying results. And therefore on your profit margins.

Which is where Cotes humidity management know-how comes into play ...

# PLETHORA OF PARAMETERS

## Two sides of the same story

The relative humidity of air decreases when it is heated.  
The warmer the air, the more humidity it can contain.

Nature always tries to establish an equilibrium.  
In the drying process, the warmer air (with a lower relative humidity) will surround the particle, and quickly adsorb the water present on the surface of the particle.

Afterwards, due to the difference in vapour pressure between the particle and the air, water inside the particle will begin moving towards its surface, where it is adsorbed by the dry air, until the particle reaches the desired level of dryness.

## What determines performance

Lots of different parameters are involved in determining the technical performance of industrial spray drying operations.

## What goes in ...

The effectiveness of transferring energy from the air to the surface of the material depends on

- > temperature
- > levels of moisture in the air
- > air flow and direction
- > pressure
- > area of exposed surface
- > shape and structure of the material.

## What comes out ...

The effectiveness of transferring moisture from inside the material to the surrounding air depends on

- > the physical nature of the solid
- > temperature
- > levels of moisture in the material
- > the rate of liquid or vapour diffusion  
(depending on the temperature and the possibility for penetration of the solid particle surface)
- > hydrostatic pressure difference.

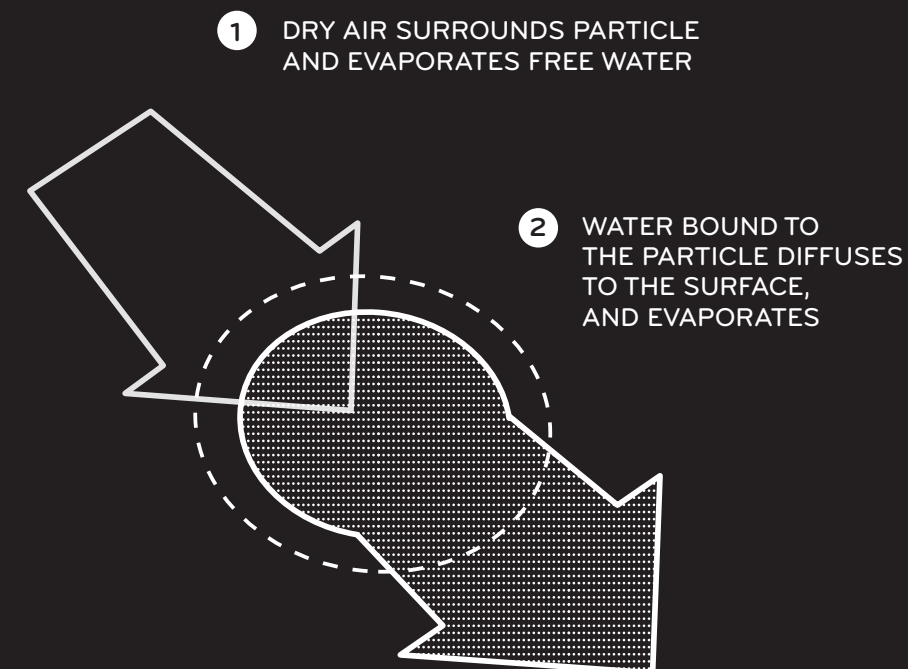
## If performance isn't bang on

Though seemingly straightforward in layman's terms, drying is actually a complex thermodynamic process – and it can result in a wide range of different physical and chemical transformations. These in turn can have substantial effects on product characteristics and product quality.

Common physical changes include

- > shrinkage
- > puffing
- > crystallisation
- > phase transitions.

FIGURE 03  
THE DRYING PROCESS OF PARTICLES



In some cases, undesirable chemical or biochemical reactions may occur. These can result in changes in key properties, such as

- > colour
- > texture
- > solubility
- > odour
- > taste.

These distinctly bothersome phenomena are often a big part of the technical challenges involved in spray drying.

As a result, many companies tend to err on the side of caution when setting temperatures for the inlet and outlet air. It's better to be careful than to damage or spoil the product.

# BETTER CONTROL OF WHAT'S HAPPENING

## The humidity multiplier

Many different parameters can affect your company's drying results. And they are far from easy to control.

But the one single parameter that is often easiest to tackle, and bring under control – and will probably have the biggest overall effect – is the levels of moisture present in the air.

## Drier inputs, bigger outputs

If you install adsorption dehumidification equipment to reduce the levels of moisture in the inlet air (the specific humidity), it's then possible to operate with hotter inlet air – with no likelihood of undesirable “nasty” effects.

The hotter air, the greater its drying capacity, and the spray drying installation becomes more cost-effective. And – if you're using a system featuring Cotes technology – it is possible to dry a greater quantity of the product material by reusing some of the thermal energy in the system.

Or, to put it another way, your expensively purchased energy supplies are put to better use. Your set-up suddenly has a bigger drying capacity – as well as greater energy efficiency.

## Optimised at the outlet

If the specs of the inlet air aren't entirely stable, it's even more difficult to manage what comes out. This can mean frequent – sometimes even every 10 minutes – manpower-intensive checks to be sure everything is OK.

But to deal with the margin of uncertainty about what's really going on, operators unfortunately have a natural tendency to give the figures a nudge. For example, if the target humidity for the powder is 4%, many companies will in practice see their product getting dried to 3% – just to make sure.

But this 1% difference means the company will be selling 1% more product (which could have generated additional revenue), instead of 1% water – and the energy consumption for making this error is also more than budgeted.

Installing an effective dehumidification system to pre-dry the inlet air enables you to eliminate this potentially costly variable.



# BIG FINANCIAL PAYBACKS – FAST

## LESS GOES IN – MORE COMES OUT

If moisture can be removed from the ambient air before it enters the spray dryer, you can increase your drying capacity.

And the greater the drying capacity of the incoming air, the more revenue you can generate.

### Rapid ROI, revving up revenue

Cotes adsorption dehumidification systems provide you with a remarkably rapid return on what is only a relatively limited investment. Cotes dehumidification systems are normally relatively small units that deliver a lot of bang for your buck.

Payback times are normally less than 12–18 months (based solely on the energy savings you can achieve in your spray drying installation).

### Capacity boosts

And then there are the financial paybacks and revenue boosts you can achieve from increasing drying capacity and throughput.

Having air moisture conditions under full control, regardless of conditions outside, can result in as much as 35% greater capacity – with big benefits to balance sheets.

### Fewer glitches

You can probably also bump up revenue because effective humidity management paves the way to avoiding quality problems due to “singled” or otherwise spoilt product and/or excessive moisture levels.

Better product specs can help you tweak revenue flows – in the upward direction. And they can also help relieve some of the pressure on your production set-up as a whole.

### Less giveaway

Full control of moisture conditions can also help you slice small margins off product giveaway. Any output that is actually drier than the negotiated specs means more giveaway and less revenue per input. Effective humidity management helps you prevent all this.

Better control of output can also help enable you to comply with more stringent product specifications, easing the way to new parameters for delivery terms and price negotiations.

# MAPPING THE CHANGES

## Conditions change

Humidity management plays an important role in determining what happens to the material in the course of the spray drying process.

The flow of air undergoes significant changes during spray drying. In the specialist world of humidity management, these are best explained by Mollier's diagram.

These industry-standard diagrams map the relationship between the heat content (also known as enthalpy) and the water vapour content of air. This mapping involves plotting the relationship between temperature and relative humidity on the one hand and absolute water vapour content on the other.

During spray drying, the air becomes colder and more moisture-laden (as shown by the enthalpy line). The moisture-laden particle absorbs thermal energy, and this heat makes the particle release some of its moisture content into the air flow.

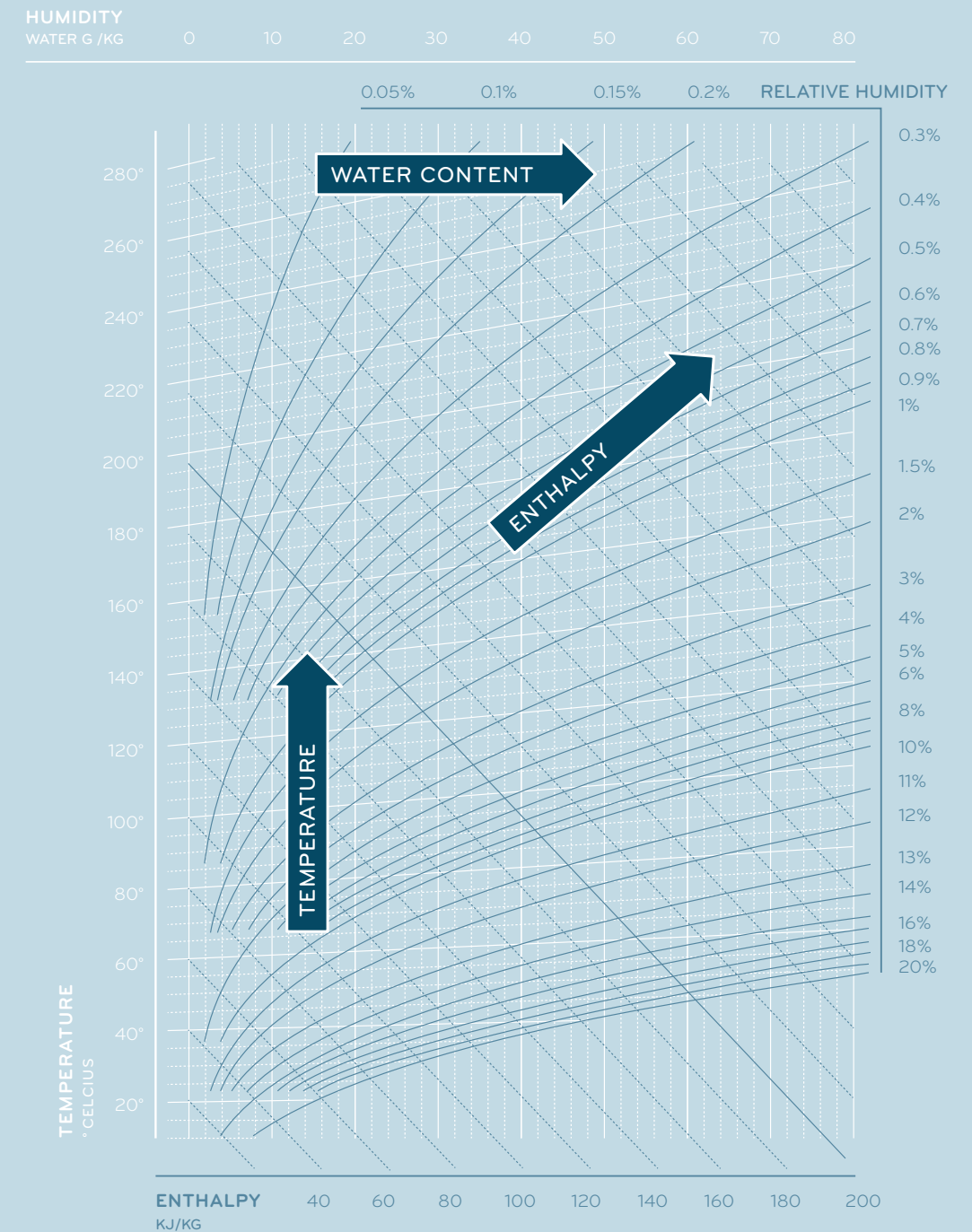
The longer the enthalpy line in a Mollier diagram for a spray drying process, the more water you are removing from the product, and the more effective your spray drying set-up becomes. So “stretching” the enthalpy line is definitely a good thing.

## Practical issues

But making this line long can sometimes result in big practical problems.

- > If the temperature of the air entering the drying chamber is too high, it can “sing” the material you’re trying to dry. This can result in all kinds of detrimental effects, including altering the colour, surface texture, smell and its physical properties.
- > If the temperature of the air leaving the drying chamber is too low, the level of moisture remaining in the product material will be too high. Too much moisture then affects product quality, shelf life and weight, as well as considerably reducing drying output in relation to the quantities of costly thermal energy you’ve used.

FIGURE 04  
MOLLIER DIAGRAM



### Only one way to stretch

The enthalpy line can be extended at the upper end, by increasing the temperature at the inlet and at the same time reducing humidity in the incoming air flow.

As shown in the diagram below, the temperature of the material ( $T_w$  in figure 05) remains constant until the moisture on the surface of the particle has evaporated. Only then is there any practical likelihood of the temperature of the material rising, which would affect its quality and other key characteristics.

This means that extending the enthalpy line by increasing the temperature and reducing humidity at the air inlet increases your throughput without giving rise to quality problems – providing the feed is balanced to match the new and increased drying capacity.

### TWEAKING THE PARAMETERS

There are lots of different factors that influence the efficiency of your particular spray drying installation.

These probably include

- > the dry matter content of the input material
- > feed rate
- > viscosity of the material being dried
- > temperature of the flow of incoming air
- > relative humidity of the flow of incoming air.

Normally, the easiest – and cheapest – ones to tackle are temperature and humidity.

### Finding the best balance

This is why effective humidity management is basically a question of balancing and fine-tuning the quantity of dry air (and therefore its drying capacity) against the quantity of moisture on the surface of each particle in the material being dried.

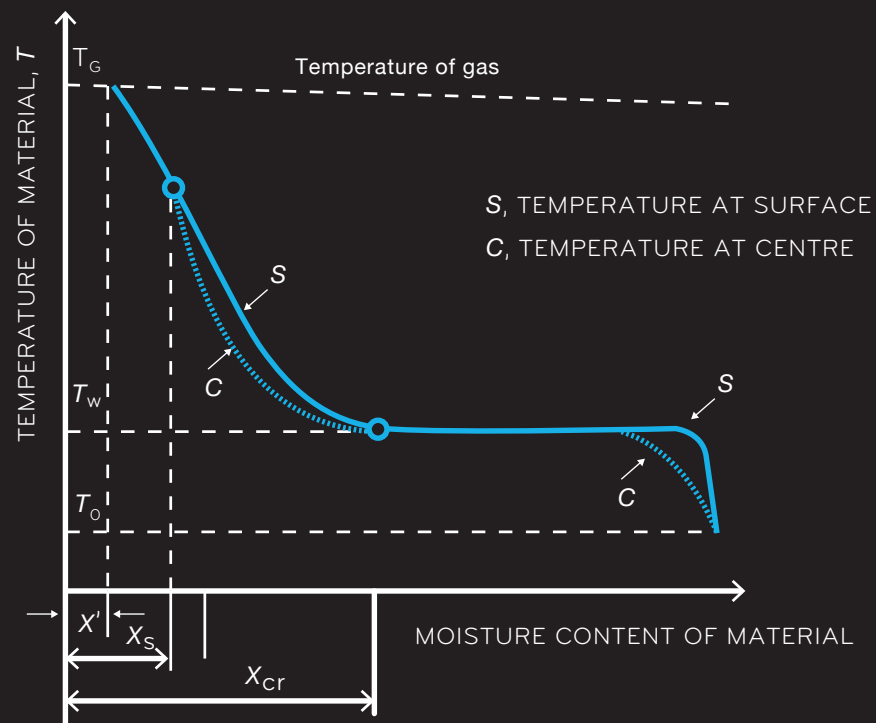
This means that if you increase the drying capacity of the air by installing a dehumidifier, and increase the input of the material being dried, the temperature of the material will not increase – but the throughput of your spray drying installation will.

### Boosting throughput

All other things being equal, greater throughput is likely to be a key component in achieving better results and greater profitability for any spray drying installation.

You can normally do this by pre-drying the incoming flow of air and increasing its temperature at the same time – with no negative effects on product characteristics, specifications or quality.

FIGURE 05  
CORRELATION BETWEEN MATERIAL TEMPERATURE  
AND MOISTURE CONTENT



Source: Arun S. Mujumdar, Handbook of Industrial Drying



# BEING LIMITED BY HUMIDITY CONDITIONS MEANS

- > The output of your spray drying plant is largely determined by climate and ambient humidity outside the plant, a consideration that is beyond your control.
- > Fluctuations in ambient humidity affect how well you can control your spray drying operations, and therefore affect product quality.
- > It's extremely difficult to maintain effective control over your spray drying operations because of problems stemming from unmanageable fluctuations in ambient humidity.
- > Your staff tend to adopt a general mindset of “keeping on the safe side”, feeling that it's better to remove too much moisture than too little, to make sure the end product is not too humid. Unfortunately, a lower moisture content in the final product can put pressure on your profit margins.
- > Your plant uses too much energy in relation to the output.
- > The return on investment associated with your spray drying plant isn't as high as it could get.

# NOT BEING LIMITED BY HUMIDITY CONDITIONS MEANS

- > You can increase the throughput of your spray drying plant by as much as 35%.
- > You can increase the energy efficiency of your spray drying operations by as much as 15%.
- > You can keep the output from your spray drying plant consistent and predictable, avoiding being at the mercy of ambient humidity.
- > Any fluctuations in the humidity outside the plant — or the gradual effects of climate change — do not affect your spray drying process, or the product quality.
- > The output from your spray drying plant can still be kept under full control under marginal conditions, resulting in products whose specifications you and your customers can rely on.
- > Substantial improvement in your return on investment in the spray drying plant, as well as in auxiliary equipment. Payback time can be as little as 12–18 months, based solely on energy savings.

### 3/ ALL A QUESTION OF KNOW-HOW

# MEETING THE CHALLENGES

## Humidity can be a handful

Uncontrolled levels of humidity in the flow of air entering your spray drying installation can give rise to all kinds of difficulties.

The two biggest sets of problems arise when:

- > humidity is high
- > humidity fluctuates.

Cotes technology, know-how and practical experience are the best way to deal with these issues, in order to harvest the full benefits of dehumidification in spray drying installations.

# DEALING WITH HIGH HUMIDITY



### Higher humidity, lower capacity

If the ambient air entering your spray dryer contains high levels of moisture, the drying capacity of your installation will be low.

Basically, the air is already “wet” when you need it to carry out the drying. That’s like using a wet cloth to dry off a table.

### Lower humidity boosts drying capacity

But if your plant is confronted with high humidity and you use a dehumidifier to pre-dry the air entering your spray drying set-up, it becomes possible to boost your plant’s overall throughput by as much as 35%.

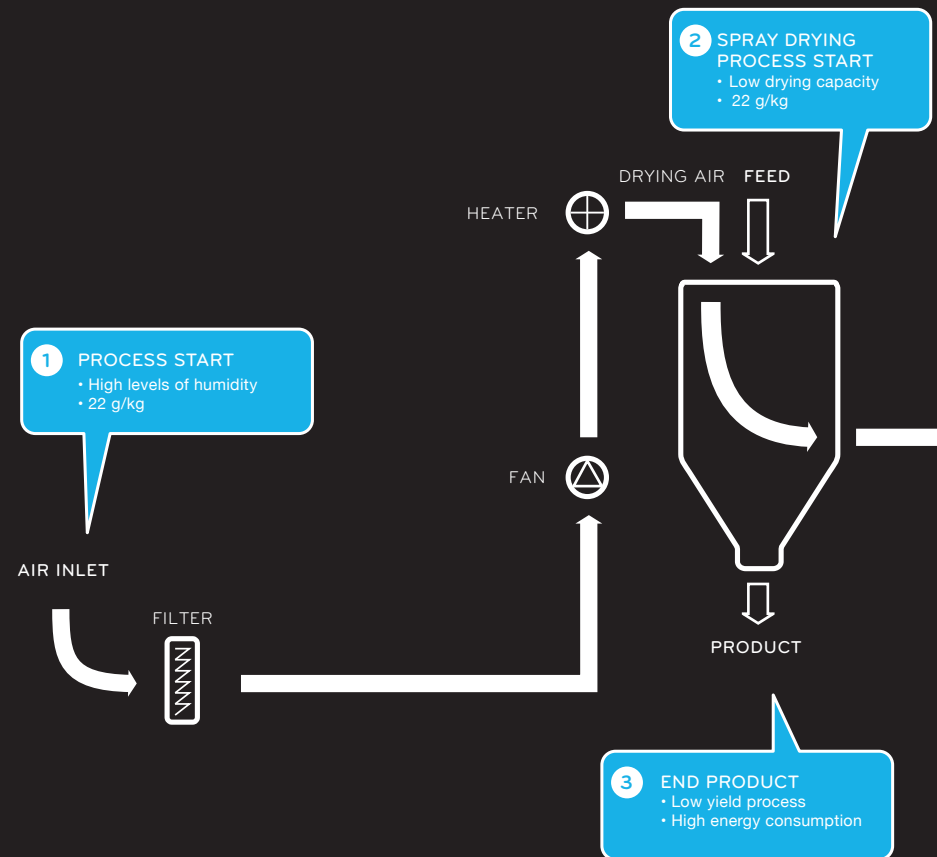
This is particularly useful in parts of the world where the climate is relatively humid all year round.

### HOW YOU BENEFIT

ADSORPTION DEHUMIDIFICATION ADVANTAGES	BENEFITS ADD UP
Removing moisture from the input air increases your drying capacity	Up to 35% higher throughput, and greater revenue
Greater consistency in operating parameters, regardless of outdoor conditions	Boosting overall throughput
Improving the specifications of the air being heated has a big influence on drying results	Better-quality output



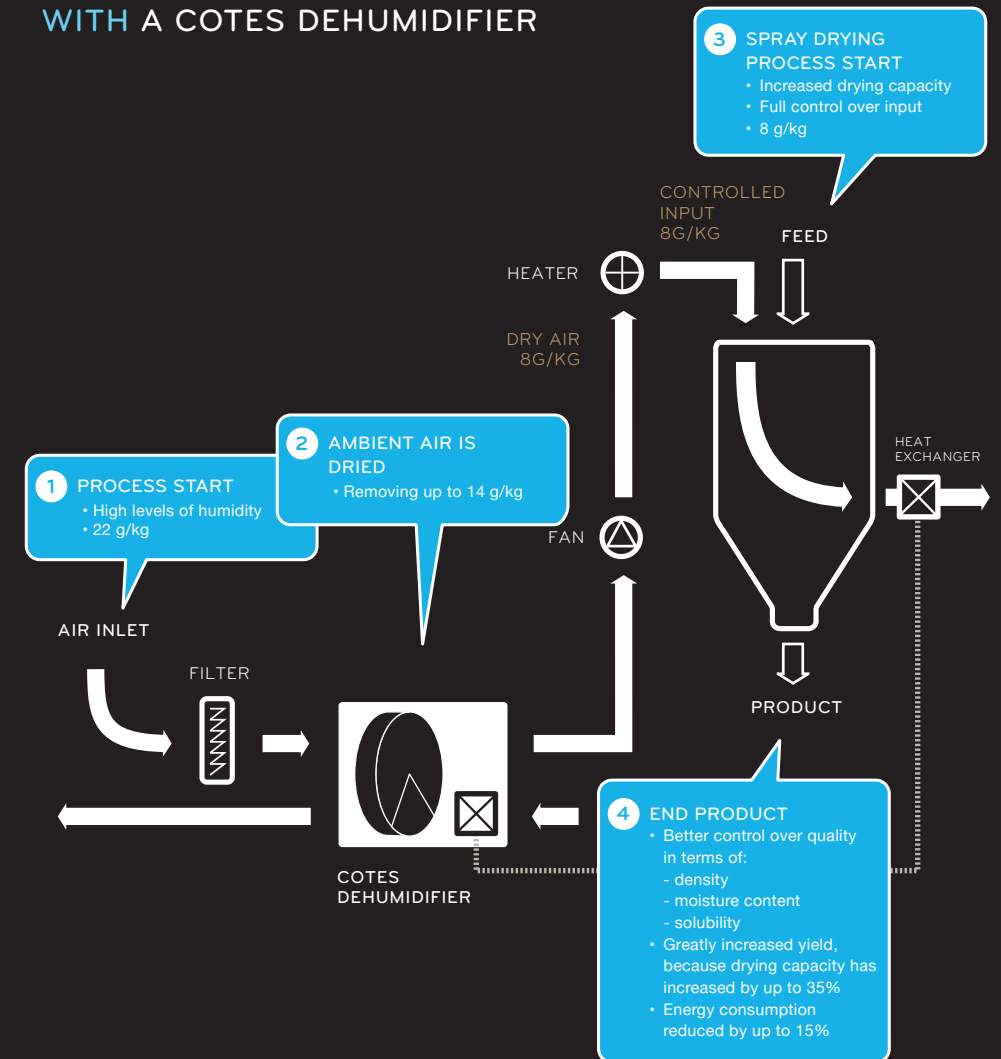
FIGURE 06  
SPRAY DRYING SET-UP  
WITHOUT A DEHUMIDIFIER



**1 → 2** The air from outside the spray tower is heated.

**2 → 3** The spray drying process, during which the temperature of the air falls and the moisture content of the product decreases, while the moisture content of the air increases – the moisture is transported from the product to the air.

FIGURE 07  
SPRAY DRYING SET-UP  
WITH A COTES DEHUMIDIFIER



**1 → 2** The air from outside passes through a dehumidifier, normally reducing moisture levels by as much as 14 g/kg.

**2 → 3** The dried air is now heated to a higher temperature than in installations without a dehumidifier. At the same time, the feed is increased by an amount corresponding to the increase in drying capacity.

**3 → 4** The spray drying process. The drying capacity of the air is now increased by up to 35%, enabling you to increase the output of your spray drying plant by a corresponding amount.

FIGURE 08  
MOLLIER MAPPING – **WITHOUT** DEHUMIDIFIER

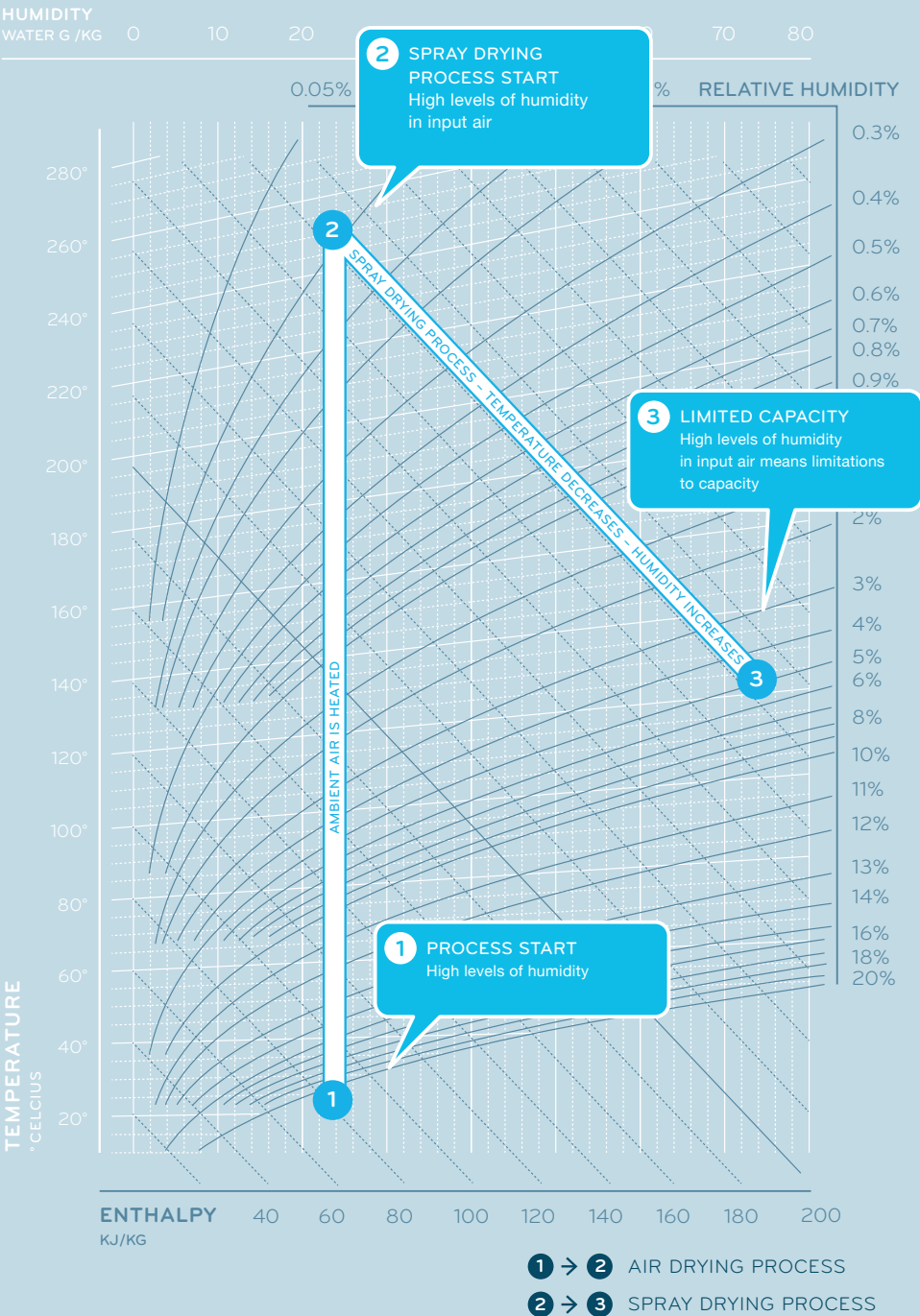
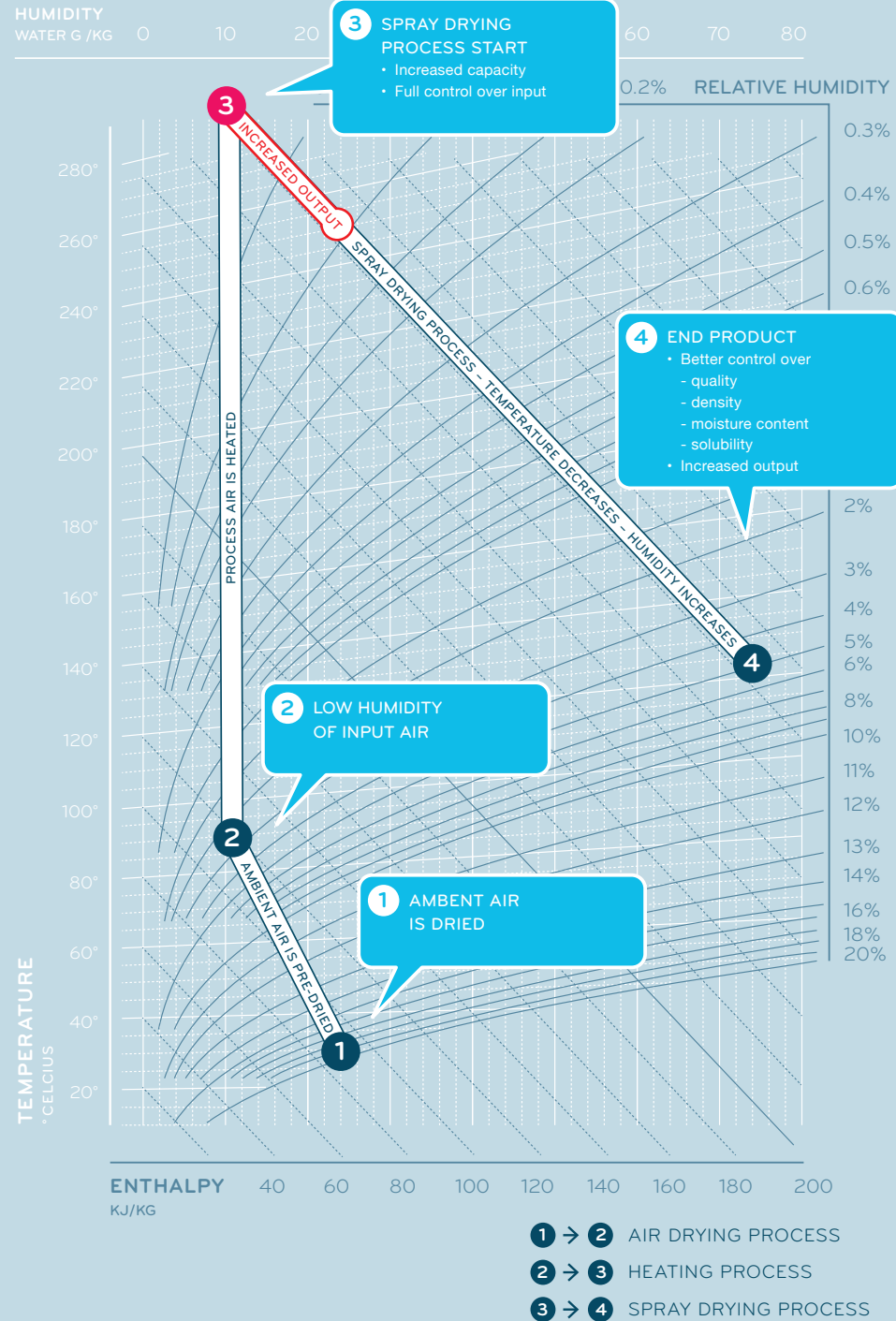


FIGURE 09  
MOLLIER MAPPING – **WITH** DEHUMIDIFIER



# TACKLING FLUCTUATING HUMIDITY



## Fluctuating humidity, unpredictable results

If the relative humidity of the ambient air entering your spray drying set-up is rarely constant – probably due to weather, climate or the changing seasons – this can give rise to substantial practical challenges.

It is usually necessary to make constant changes to feed flows and temperature inputs in order to balance and counteract the effects of fluctuating humidity. Doing this requires close monitoring by skilled operators, but the inevitable under- and over-compensation still results in unpredictable drying results and product specifications. All of which eat into your profit margins.

Mapping such conditions on a Mollier diagram reveals continual changes in the enthalpy line.

## Pre-drying – preventive and productive

Using a dehumidifier makes it possible to pre-dry the flow of air entering your spray drying set-up, and to make sure its specifications are both on-spec and reliably consistent.

This means you can both increase the temperature of the air input and the feed flow, resulting in greater throughput for your spray drying plant.

And your output figures get an additional boost because full control over the conditions of key inputs enables your staff to adjust operating parameters closer to ideal numbers.

## Consistency counts

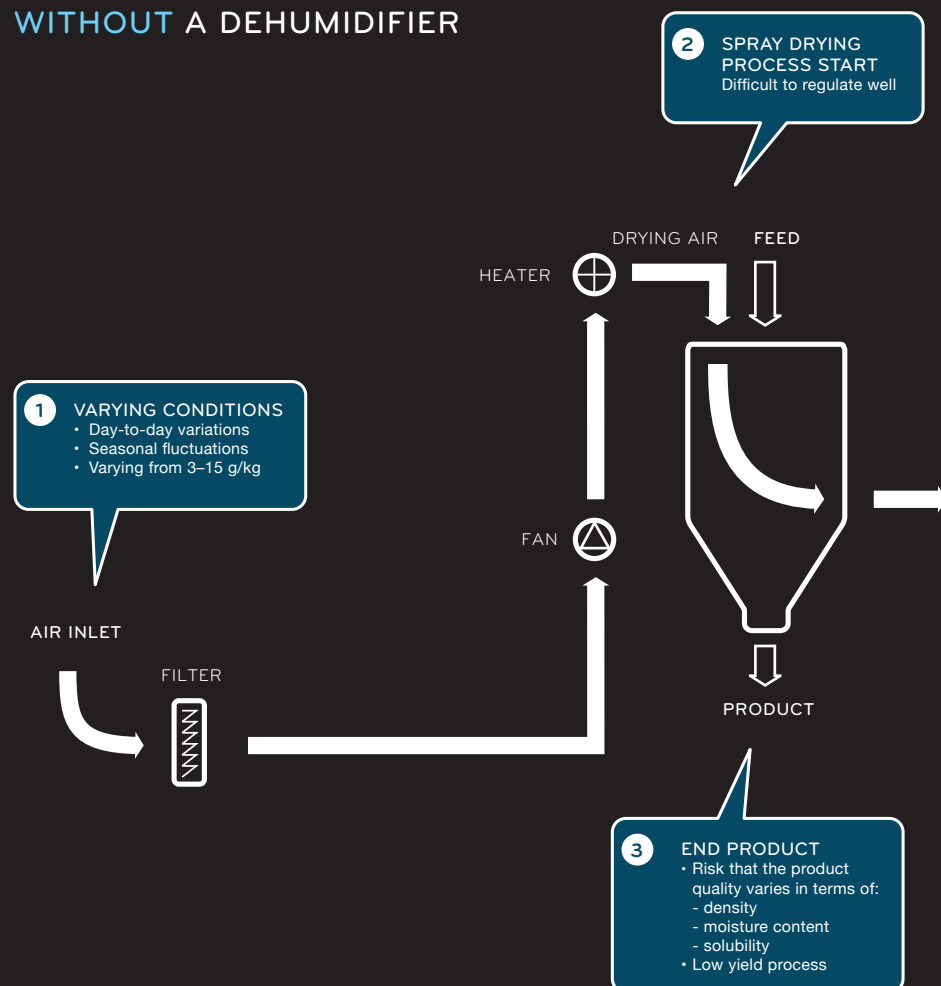
Pre-drying the flow of air into your installation also has a big effect on product quality and specifications, turning an unpredictable variable into a controllable constant.

It means you can be sure of consistent, predictable results all year round, regardless of season or other conditions outside.

HOW YOU BENEFIT	
ADSORPTION DEHUMIDIFICATION ADVANTAGES	BENEFITS ADD UP
Better control of conditions in the air	Better control of all other parameters in the spray drying process
Better control of your product specifications	Customers that are more satisfied with your deliveries
Avoid the effects of weather, seasonal change and climate change	Consistent operating conditions all year round
Avoid operators over-compensating for fluctuating conditions	Optimised operating conditions, closer to ideal technical parameters
Full control even under marginal conditions	Products specifications you and your customers can rely on
Consistent conditions prevent wasting re-sources on dealing with production snafus	More effective use of manpower and resources



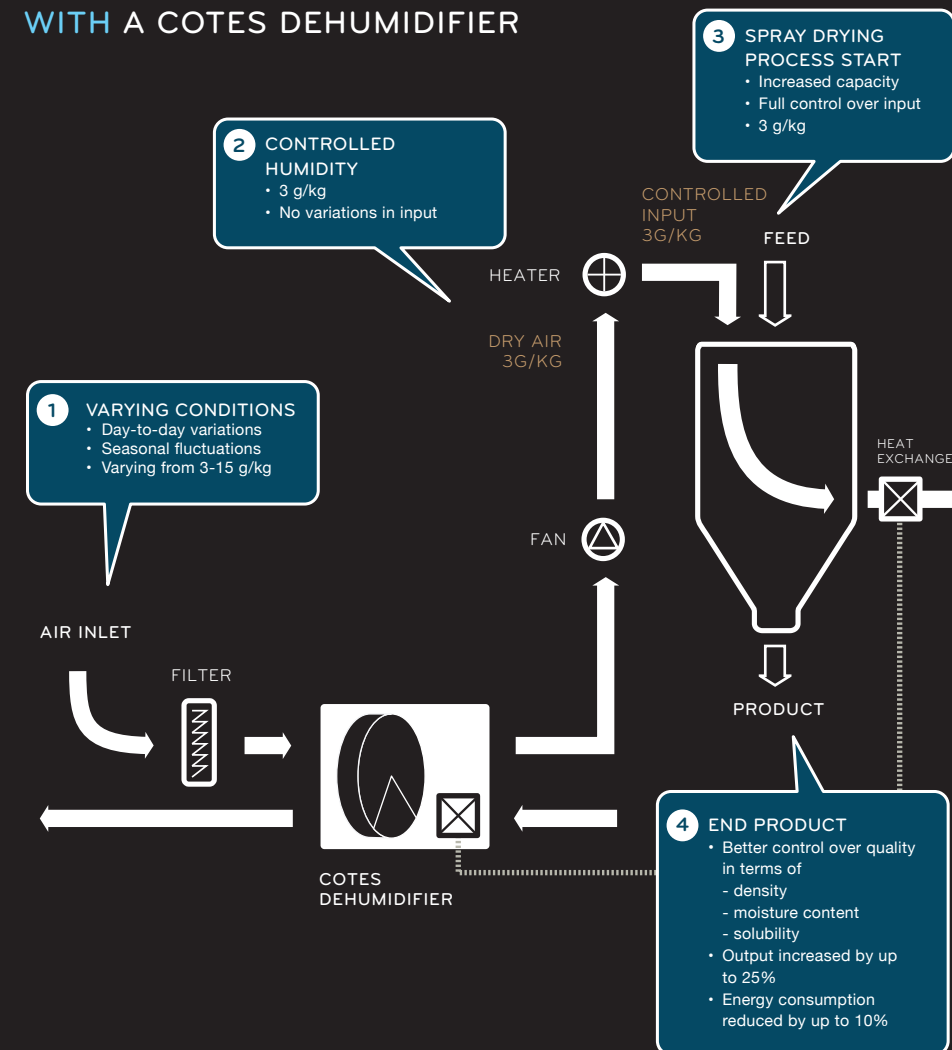
FIGURE 10  
SPRAY DRYING SET-UP  
WITHOUT A DEHUMIDIFIER



**1 → 2** The air from outside the spray tower is heated.

**2 → 3** The spray drying process, during which the temperature of the air falls and the moisture content of the product decreases, while it increases for the air. The moisture is transported from the product to the air.

FIGURE 11  
SPRAY DRYING SET-UP  
WITH A COTES DEHUMIDIFIER



**1 → 2** The air from outside passes through a dehumidifier, reducing the moisture level to a constant predefined level (removing up to 12g/kg)

**2 → 3** The dried air is now heated to a higher temperature than in installations without a dehumidifier. At the same time, the feed is increased by an amount corresponding to the increase in drying capacity.

**3 → 4** The drying capacity of the air is now increased by up to 15–20% averaged across the year, enabling you to increase output of your spray drying plant by a corresponding amount.

FIGURE 12  
MOLLIER MAPPING – **WITHOUT** DEHUMIDIFIER

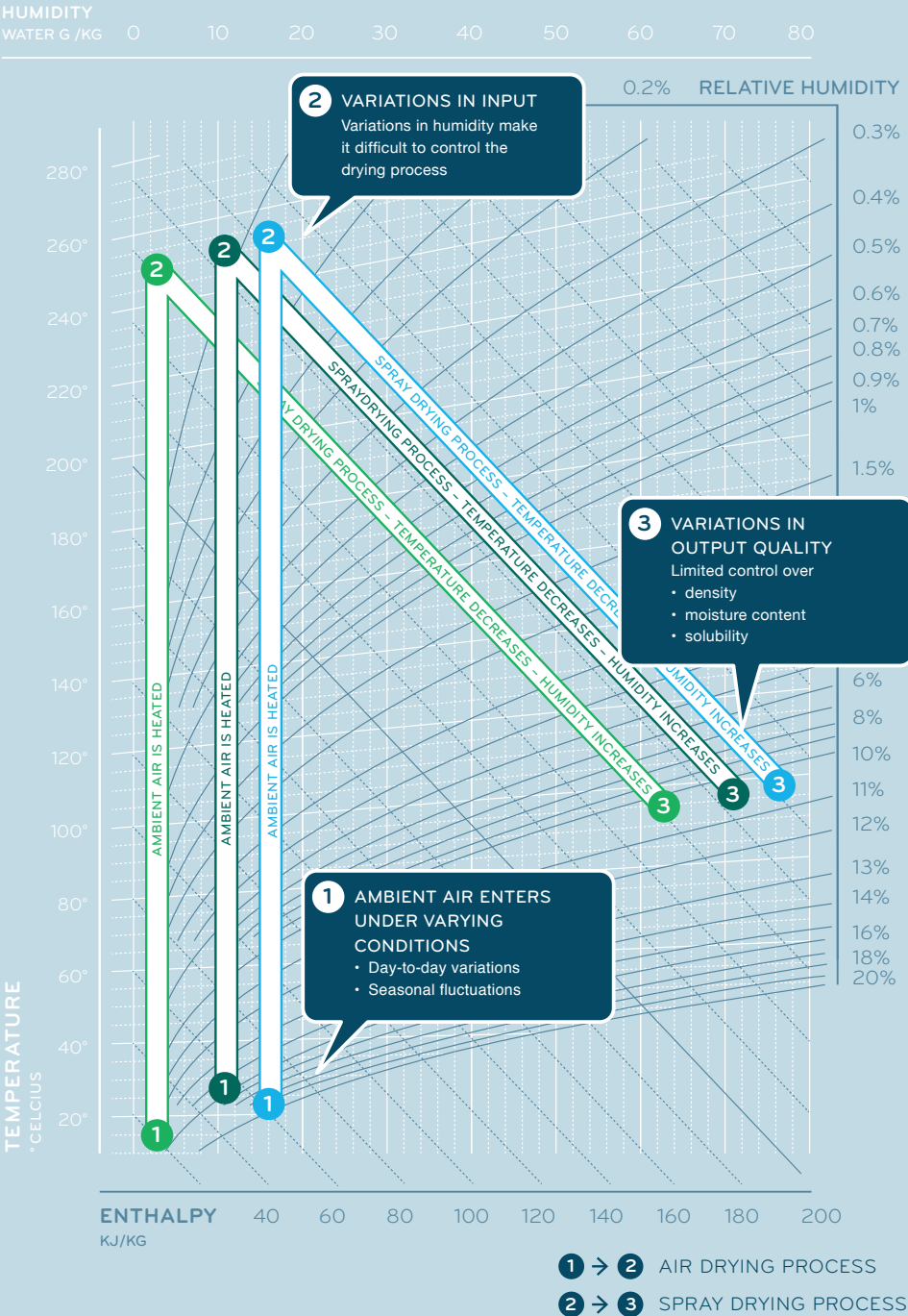
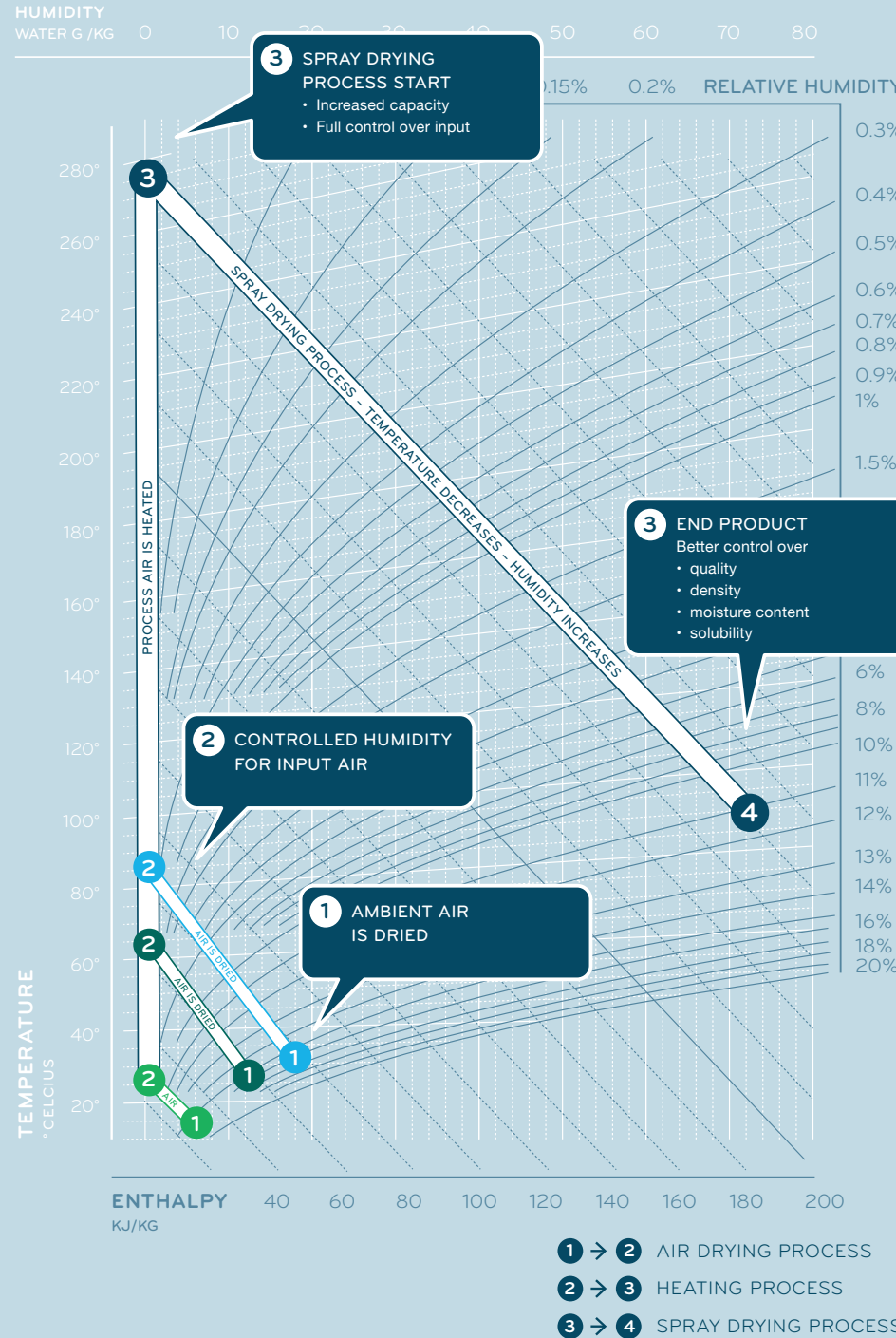


FIGURE 13  
MOLLIER MAPPING – **WITH** DEHUMIDIFIER



# MANAGING AIR CONDITIONS IN FLUID BED SYSTEMS

## Forget fluctuations

Cotes dehumidification systems enable you to deal effectively with fluctuations in air specifications due to climate, season and weather.

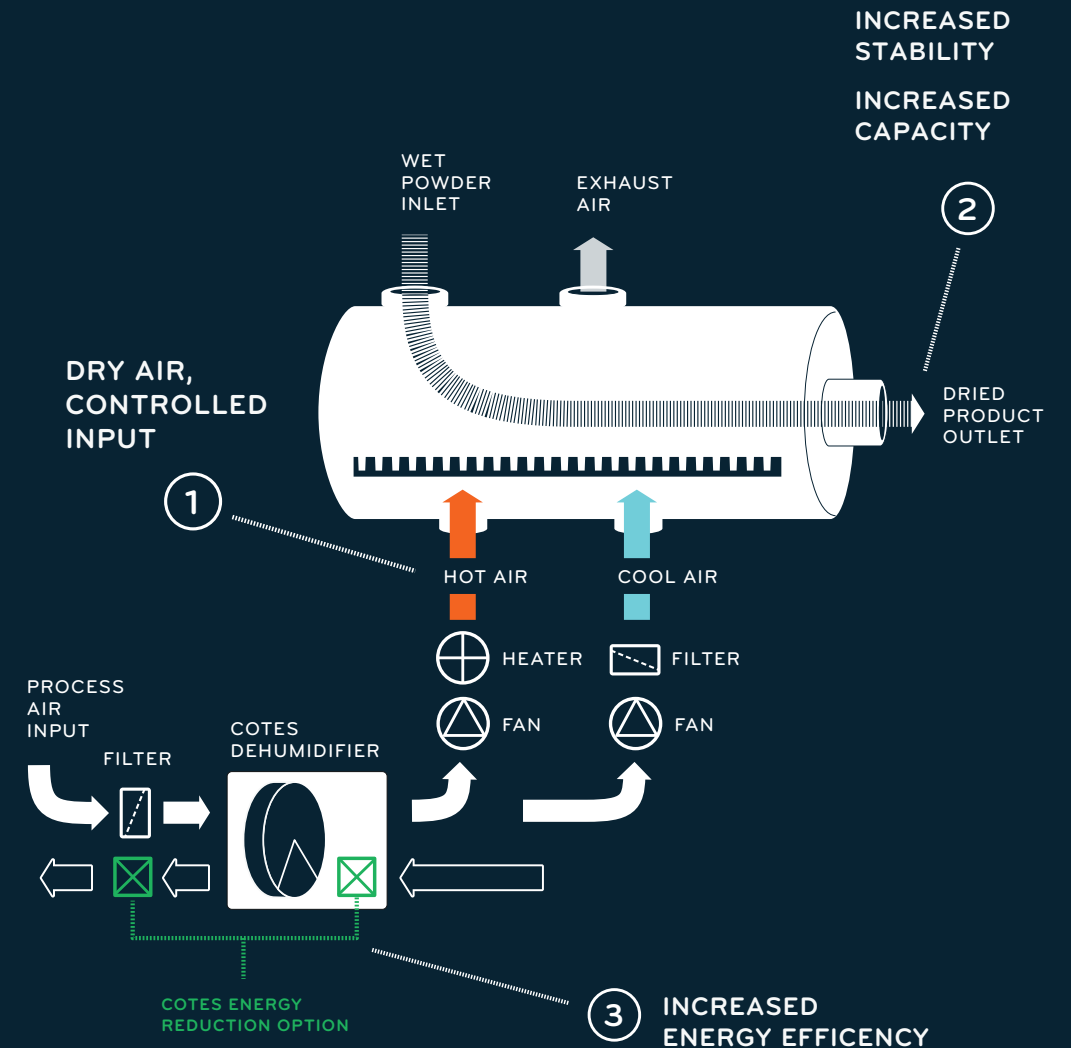
Full control over the levels of moisture in the air enables you to make sure of consistent operating conditions for your installation, as well as ensuring consistent product quality.

INCREASED  
STABILITY

CAPACITY  
INCREASED  
BY UP TO

20%

INCREASED  
ENERGY  
EFFICIENCY



# REDUCING ENERGY CONSUMPTION



## Optimising energy use

Ice-water cooling – based on condensation – is widely used in both spray drying and fluid bed drying. It’s often considered a safe, familiar technology.

But it involves using inordinate amounts of costly energy – with relatively big environmental impacts – to cool flows of air that later have to be heated. In terms of overall energy efficiency, this is counter-productive.

Using adsorption dehumidification technology instead, and thus significantly improving overall energy efficiency equations, makes much more sense.

HOW YOU BENEFIT	
COTES DEHUMIDIFICATION ADVANTAGES	BENEFITS ADD UP
Humidity management means You don't waste energy heating up moisture in the input air	Lower energy consumption
Cotes systems can use thermal inputs from any available source – including waste heat	Energy bills reduced by as much as 15%
Makes it possible to use thermal inputs you already have	Available steam can be used to pre-heat inlet air at relatively low cost

## Unique energy-saving solution

Cotes can also provide a unique energy-saving solution (for which we have applied for a patent). This exploits waste energy from the flow of air exiting the spray drying installation in order to power the dehumidifier.

This reduces the overall energy consumption for the spray drying installation by approx.:

- > 8–9% in relation to traditional adsorption dehumidifiers
- > 15–17% in relation to not using a dehumidifier at all
- > 24% in relation to using chillers or ice-water cooling.

## Cheaper energy

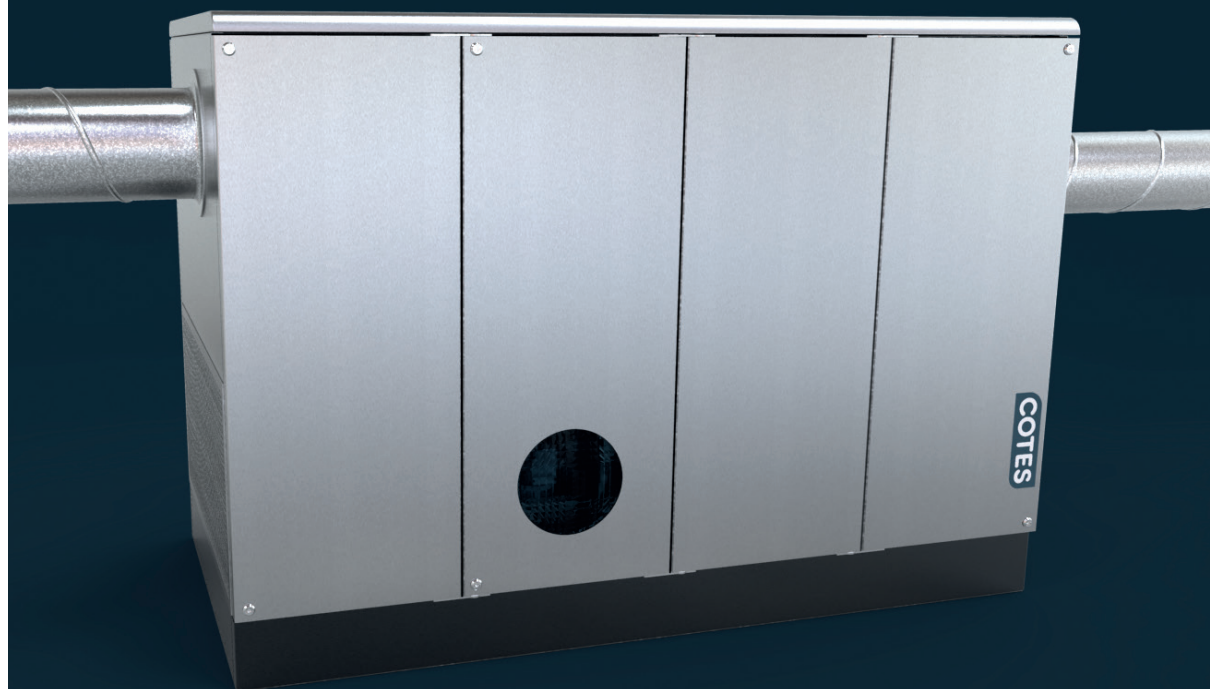
Adsorption dehumidification also has the advantage of being able to use less expensive sources of energy, including gas, steam and recycled waste heat, to control the humidity of air flows for spray drying and fluid bed drying systems.

This normally corresponds to energy prices that are up to 17% lower than when using chillers and/or ice water condensation systems.



## 4/ COTES DEHUMIDIFICATION SOLUTIONS

# WHAT YOU GET



### Big bonuses

Using adsorption dehumidification to control the levels of moisture in the flow of air entering the spray dryer provides big benefits.

- > Up to 35% more production capacity
- > Consistent production all year round.
  - Production is no longer affected by changing weather and other conditions outdoors – including the increasingly volatile effects of climate change
- > Consistent product standards and specifications all year round. Stable conditions for inlet air enable you to ensure consistent quality, and to secure any price premiums resulting from this.

### Energy advantage

One of the big extra benefits of Cotes dehumidification technology is the unique system that enables you to use thermal energy recovered from your spray dryer to power the dehumidification system.

This means big savings on energy costs, ensuring your initial outlay gets paid back even faster.

### Cotes solutions – better payoffs

Doing it the special Cotes way enables you to add even more advantages and benefits to the equation.

- > Up to 35% increase in drying capacity
- > Up to 15% reductions in your energy costs
- > Any kind of thermal inputs can be used to remove moisture from the inlet air – electricity, gas, steam or surplus energy from other processes. This enables you to select the cheapest source of energy available at each particular spray drying location – and even change these over time
- > No need for as many operators to make repeated adjustments – which means you save on laboratory expenditure as well as manpower costs
- > Greater reliability that helps you keep downtime to a minimum
- > You can draw on the expertise and resources of Cotes distributors throughout the world
- > Payback on your investment within 12–18 months (based solely on energy savings. Greater throughput speeds up your payback time still further).

# DESIGNED TO MEET INDUSTRY NEEDS

## Attention to detail

Cotes dehumidification units for use in spray drying installations feature a comprehensive range of practical details that put them streets ahead of the generic types of equipment normally available.

## Cleanliness and hygiene

- > The inner and outer surfaces are easy to clean, saving on time and manpower.
- > They're also designed and built so they are easy to keep clean, avoiding crevices where dirt or bacteria can collect.
- > Cotes dehumidification units are available in a range of different materials and finishes inside and out, including AISI 304 and AISI 316 stainless steel. This makes it easy to comply with stringent food industry hygiene requirements.

## Versatility and use with different energy sources

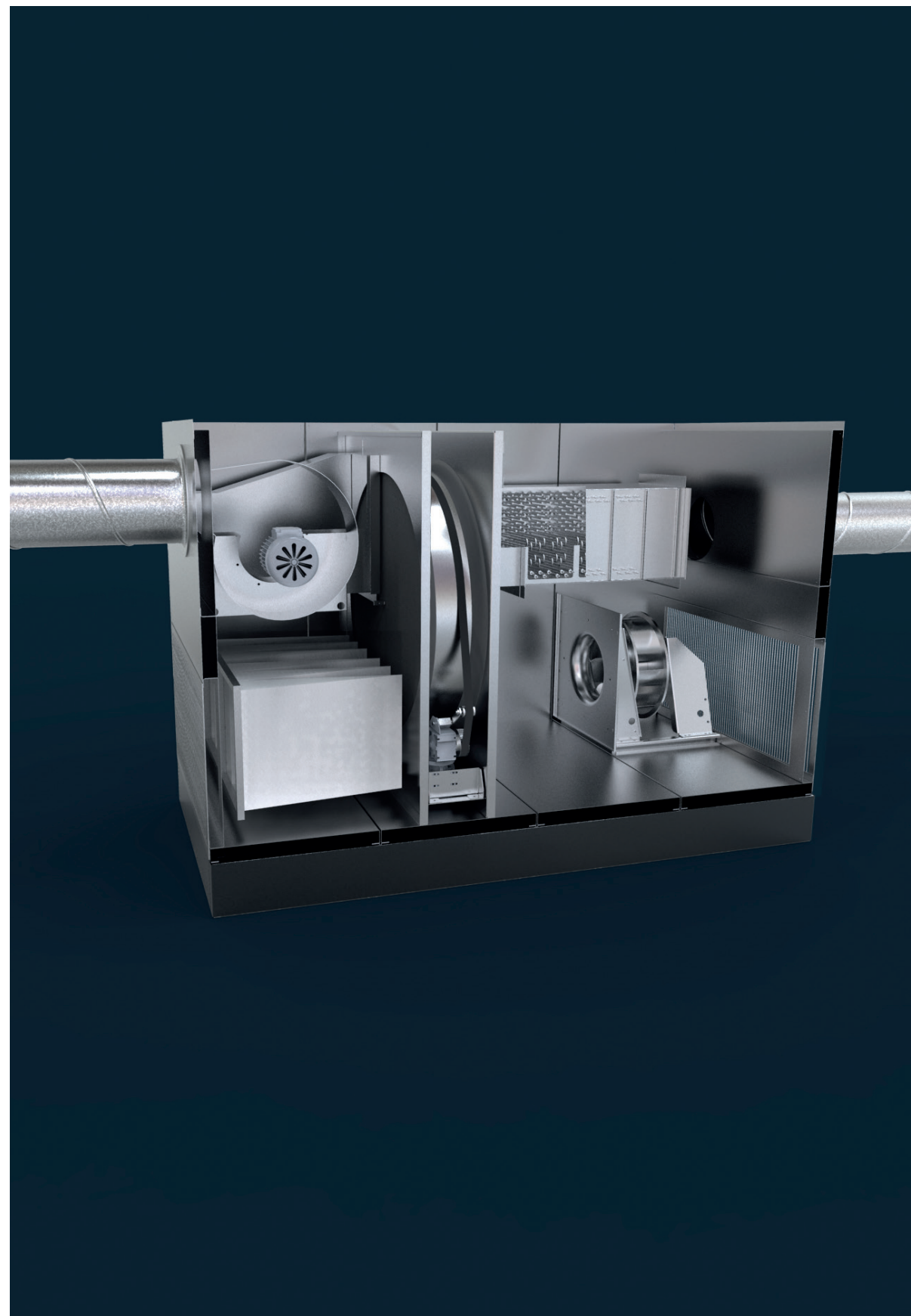
- > Can be used with virtually any energy source available (gas, electricity, steam, district heating, surplus heat, etc.).
- > Flexible design makes it easy to change the type of energy used after installation, to keep operating costs to a minimum.
- > Can be used with different electrical current set-ups (200V, 230V, 415V, etc.).

## Easy integration with modern control systems

- > Easy to integrate with industry-standard PLC equipment and systems.
- > Can be set up to provide appropriate warnings and alarms.

## Durability, easy service and low life cycle costs

- > Robust, highly durable construction that ensures long service life.
- > Exceptionally efficient rotor, belt driven. Spare belt mounted on rotor for maximum reliability.
- > All fans are built into the cabinet, making them much quieter (max. 65 decibels).
- > Well-designed flows of air, with as few deflections and changes of direction as possible. This ensures minimal pressure drop, and efficient distribution of the air on hot surfaces and the surface of the rotor.
- > Top-quality components throughout, to provide maximum reliability and make sure of minimal downtime.
- > All major assemblies and components are easily available on the open market, ensuring you rapid access to parts at minimum cost, and inexpensive service.
- > Efficient filter design, meaning reliable filtration and long intervals between inspection and service.
- > Exceptionally durable seals help reduce service and maintenance costs.
- > Large service doors for easy access and service that help reduce downtime.





# HERE TO HELP YOU GET IT RIGHT

## Guidelines – not standards

Standardised, cookie-cutter solutions simply aren't the Cotes approach. We know our customers depend on rock-solid reliability, and we're well aware that any glitches or downtime can be very expensive.

There is big money at stake in getting your spray drying operations to consistently work at peak performance – or not.

## Consultations count

The conditions in any two spray drying set-ups are never quite the same, and your particular requirements will never be the same as those of another company. Nor will the conditions ever be the same in two technically identical spray drying installations located in different parts of the world, where the air has different specifications.

That's why Cotes recommendations are based on in-depth technical consultations, and conclusions based on solid data rather than presumptions and guesswork. Our humidity management experts work

with your managers, product specialists and technical staff to be completely clear about your exact needs and expectations, and where any possible issues may lie.

Getting like minds to work together can also result in unexpected tweaks and improvements, and additional benefits.

## Talk to us about what's possible

Cotes knows what's involved in supplying adsorption dehumidification systems to some of the most demanding and technically advanced industrial customers in the world.

It can be a good idea to involve Cotes experts early on in the decision-making process, so you can benefit in full from our unique humidity management experience and expertise.

Talk to us about the conditions in your particular project or installation – and we'll find the best answer together.





# THE BIGGER PICTURE IN DRYING

## Other kinds of drying

Cotes adsorption dehumidification technology isn't just ideal for use in spray drying facilities.

Any kind of drying involving the use of warm air – i.e. convection drying – will benefit from better control of the specifications of the inlet air, with greater consistency and better profit margins to follow.

It's just that the efficiency improvements, energy savings and other benefits are greatest in spray drying, because the equipment involved is most costly and the energy bills tend to be fairly substantial.

## Fluid bed, too

In many industries, the use of spray drying is supplemented by fluid bed drying. Cotes dehumidification solutions are just as useful here, and you'll benefit from using one single supplier that helps you merge all the know-how currently available in advanced humidity management.

## Combating moisture

Not having full control over levels of moisture in the air can throw a spanner in the works in all kinds of other industrial processes, including

- > production, processing and assembly
- > packing
- > transport
- > storage.

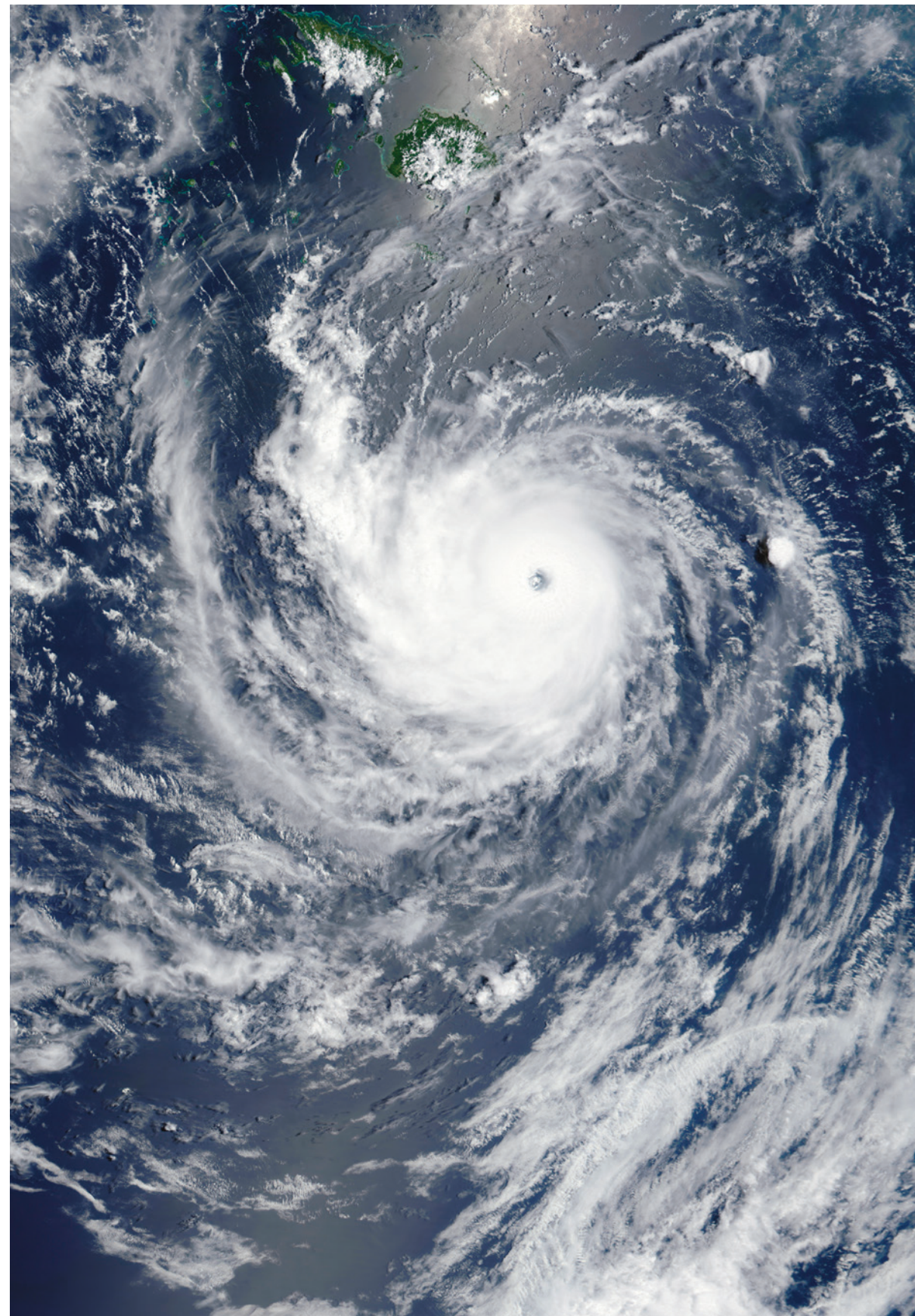
Your company has probably spent lots of time, money and energy drying the product – isn't it worth making sure that value doesn't get eroded further down the supply chain?

## Talk to people in the know

Cotes are the people to talk to about dealing with humidity in the air – in any context.

And Cotes dehumidification solutions are the most cost-effective way to tackle virtually all humidity-related problems in industry.

The payoffs will probably surprise you.





## RESUMÉ OF BENEFITS

CONSISTENT  
YEAR-ROUND  
PRODUCT QUALITY

35%

UP TO 35% MORE  
THROUGHPUT

15%

REDUCTION  
IN OPERATING  
COSTS

35%

MORE DRYING  
CAPACITY FOR ANY  
GIVEN AIR FLOW

GREATER  
RELIABILITY AND  
LESS DOWNTIME

RAPID  
RETURN  
ON INVESTMENT

Cotes provides humidity management technology and expertise that help companies using spray drying to achieve significant operating benefits on three different fronts.

- > Eliminating fluctuations in air specifications, thus reducing product inconsistencies
- > Greater throughput for any given spray drying installation
- > Savings on energy bills.

The key lies in effectively managing the levels of moisture in the air entering the spray drying installation.

### Forget fluctuations

Cotes dehumidification systems enable you to deal effectively with fluctuations in air specifications due to climate, season and weather.

Gaining full control over the levels of moisture in the air at any given time enables you to make sure of consistent operating conditions for your spray drying installation, as well as ensuring consistent product quality and specifications.

### Boost capacity

Unique Cotes expertise about the technical details of dehumidification and using this lesser-known technology in spray drying processes makes it possible for you to achieve the best possible results.

Calculations have shown that Cotes dehumidification systems are capable of boosting throughput in spray drying installations by as much as 35%.

### Save on energy

Cotes technology enables you to run our dehumidification systems using surplus or waste thermal inputs from other machinery or other processes.

This means this energy is pretty much free of charge, helping you roll back operating costs by as much as 15%.

*All figures are approximate, and will normally vary according to details in each particular installation.*

TEXT  
DESIGN

WORD DESIGN  
MARLENE HALD

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