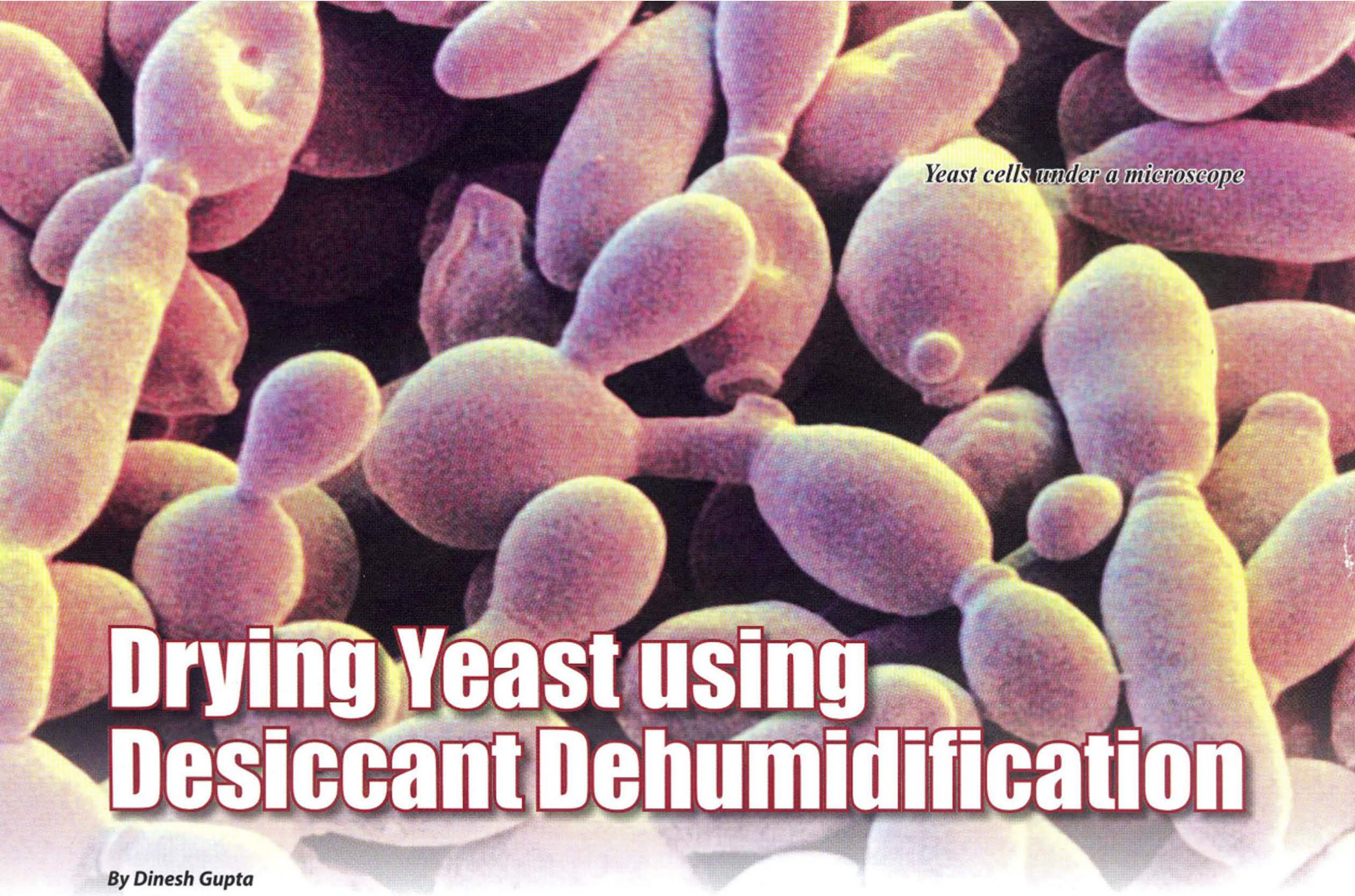

Yeast cells under a microscope

Drying Yeast using Desiccant Dehumidification

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Introduction

The word 'yeast' comes from the Sanskrit word '*yas*' which means 'to seethe or boil'.

Yeast has played a very important role in human history. Without yeast, staples like bread, beer and wine would not exist. Man has used yeast even before the development of a written language without actually knowing about its existence or understanding its role. It is believed that yeast is probably man's oldest industrial micro-organism. For centuries, yeast has been associated with bread making as a fermenting agent. The origin of bread, though obscure, dates back to the Stone Age. Flat breads were common in the late Stone Age, while raised bread originated around 4000 B.C.

Figure 1: Instant dry yeast varieties

Yeast has also helped in the production of alcohol for as long as recorded history. Traces of yeast were discovered in beer jars, and beer breads were used as offerings in the Theban tombs in 2000 B.C. Fermentation, originally a matter of chance contamination of airborne yeast, was promoted by using a piece of old dough. To this day, this is the method the most prestigious bakers choose. By 300 B.C., however, yeast-making became a specialized profession

However, it was not until relatively recently (1841) that yeasts were recognized as the cause of fermentation. Louis Pasteur is credited with the discovery that yeast was responsible for

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beer fermentation in 1866. Fifteen years later, at the Carlsberg Laboratory in Copenhagen, Emil Hansen isolated and purified individual yeast strains, and brewer's yeast started to be banked and stored. Many of the pure culture techniques Hansen developed are still in use today.

What is Yeast?

Yeast is a living, single-cell organism commonly found on plants and animals. On solid media (plates or slants), yeast barely becomes visible as a clump at one million cells. Yeast was long considered a mysterious organism as a single cell, at five microns in size, is not visible to the human eye.

The species of yeast which is used in food is called Saccharomyces cerevisiae, a Latin name that means 'sugar fungus'. Yeast used by both bakers as well as brewers belong to the Saccharomyces cerevisiae species.

Today, we have the capability to not only utilize a wide range of pure yeast strains, but also to control the environment in which the yeast reacts. Modern brewers not only know and understand the yeast strains available for use, but also understand how to manipulate the environment in which the yeast performs.

Beer is made from just four simple ingredients: malt, hops, water, and yeast. While sometimes overlooked, yeast is one of the most important of these ingredients. When it transforms sweet, hopped wort into beer, it also is responsible for the flavor and aroma of the beer.

Yeast is now commonly available is packets and foil sachets in the supermarkets *(Figure 1)*. However, there is nothing new in the function of a raising agent for imparting that special light texture to the bread we eat.

Also Used in Research

As it is readily available and easy to culture, baker's yeast is also used in chemical, biological, and genetic research. For example, most of our knowledge of the cell division cycle has come from experiments with yeast.

Some Interesting Facts about Yeast

1. *There are more than 500 species of yeast:* Brewer's yeast is just one of the 500 species, but within a single species there can be literally thousands of genetically distinct strains. Saccharomyces cerevisiae is the species in which brewer's yeast is classified.
2. *Yeast is responsible for most of the flavor and aroma compounds in beer:* Yeast contributes more than 600 flavor and aroma compounds to finished beer.
3. *The Romans discovered the uses of dried yeast – before the discovery of yeast:* Yeast grows and lives in liquid. For storage purposes it can also be dried once grown. The Romans discovered how to do this when they put baker's yeast (dough) in the sun and could later revive it with sugar. (Of course, they did not know there was yeast in the dough!) Today, most yeast used in the bread and wine industry is in dry form.
5. *Yeast transforms sugar into alcohol and CO_2*
6. *Some yeast strains really stick together:* Flocculation is the special ability of brewer's yeast to clump together following the end of fermentation. Flocculation is one yeast characteristic that is very important to brewers. Professional breweries typically reuse their yeast 10 or more generations, so yeast recovery becomes very important.
7. *Yeast would rather keep warm*: The optimum temperature for yeast growth is 32.2°C (90°F). Yeast cell death occurs above 37.8°C (100°F). At 32.2°C (90°F) yeast produce so much acetaldehyde (which tastes like apples) that the beer becomes undrinkable.

The optimum ale fermentation temperature has been found to be 20°C (68°F). This temperature strikes the best balance between yeast growth and ester levels for most ale strains.

Yeast is dried best when the temperature is low and moisture content is kept between 1.6-2 gm/kg or dew point is maintained in the region of (-) 11 to (-) 7°C (12-18°F).

The Art and Science of making Yeast:

Environmental Control Systems for Yeast Drying and Manufacturing

Yeast making is truly an art and science. It involves growing the organism in suitable media. The most popular yeast for winemaking, baking and brewing since ancient times is Saccharomyces cerevisiae, the microorganism which is prepared in the laboratory as the seed yeast.

The crop is harvested when a sufficient crop of cells appears. This is then transferred into a clear mineral salt-sugar solution and used as the medium where fermentation occurs. The temperature is kept constant for rapid growth to take place. The yeast cells are then separated from the fluid in which they have grown by a filtration process. The yeast cells are mixed with starch cells and pressed into large cakes. Fresh yeast can survive only for a week at controlled temperature of 4°C (39.2°F). Hence, it needs to be stored in specially constructed cold stores. On the other hand, dry active yeast can be kept for three years without any loss of properties.

The drying process in yeast manufacture reduces moisture content, giving it a longer shelf life

Dry yeast is fresh compressed yeast that has been pressed and dried until the moisture content is only about 8%, which makes the yeast dormant. The granules become active again only when mixed with a warm liquid. The advantage of dry yeast is it has a much longer shelf life than fresh yeast and does not need to be refrigerated.

Low Temperature Drying

Drying of yeast is an intricate process, requiring cold dry air to produce quality yeast without destroying the organism. Though elevated temperature ensures faster drying, it can spoil the product quality, as it destroys the organism, the most critical requirement for quality yeast making.

The quality of air required for drying of yeast has to be controlled and moisture content kept between 1.6-2 gm/kg (10-14 grains/lb), or the dew point of air must be in the region of (-)11 to (-)7 °C (12-18°F).

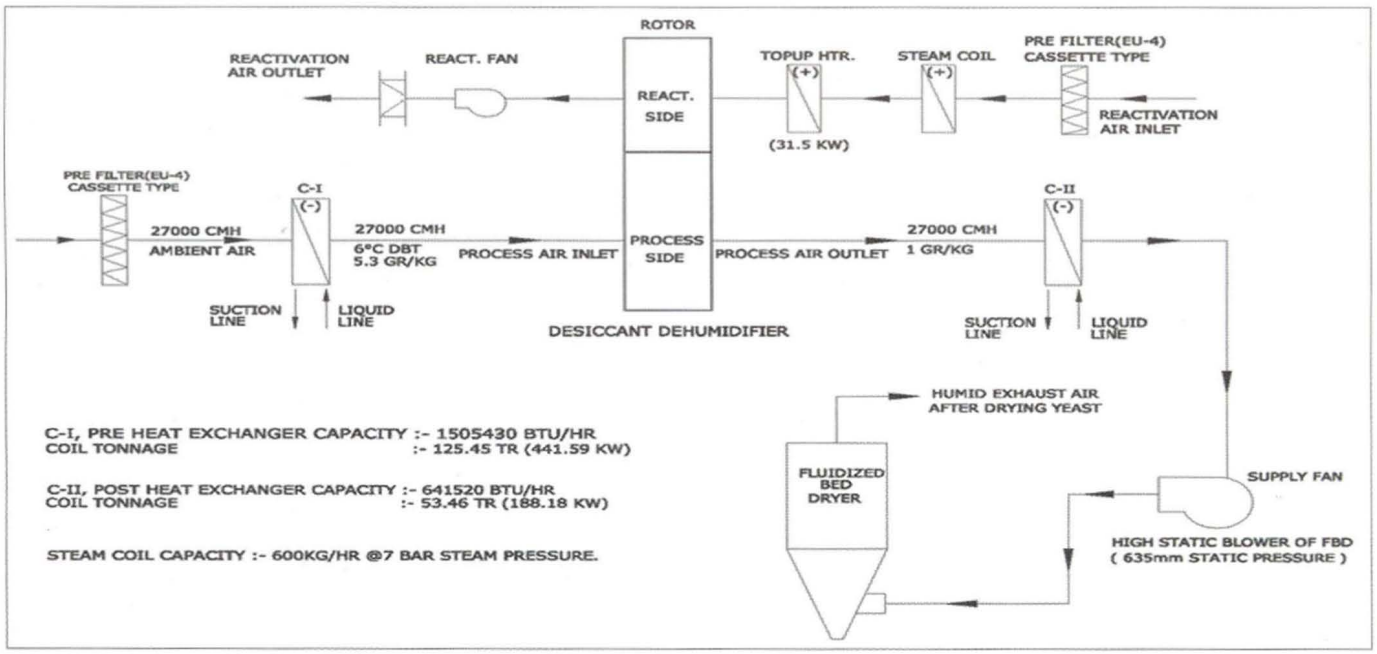

Figure 2: A typical system flow diagram of a yeast drying system for 100 tonnes/ month capacity

The Solution: Low Temperature Drying with Desiccant Dehumidification

Desiccant dehumidifiers can maintain these stringent conditions in the fluidized bed dryers used in yeast manufacturing. In conjunction with air conditioning plants, very dry air at low temperatures can be supplied for yeast drying. Desiccant dehumidifiers offer the simplest and most cost effective way since they are capable of maintaining RH as low as 1%, or even lower, at a constant level regardless of ambient conditions.

Drying of yeast is done using Fluidized Bed Dryers (FBDs). To ensure drying of yeast, inlet air to the FBD is supplied with conditioned air at low temperature of 6 to 10°C, at moisture content of 1.5 to 2 grams/ kg. A typical flow diagram is shown in *Figure 2*.

This is typically an open loop system with 100% fresh air pre-conditioned prior to inlet to the FBD. Fresh air is first pre-cooled with either DX or chilled water enthalpy coil to remove easy moisture. This cooled saturated air is then further dehumidified to about 1 gram/Kg by passing through a desiccant dehumidifier. As the desiccant dehumidification process works on the constant enthalpy line, dehumidified air has a corresponding rise in its temperature. This is cooled to the desired temperature of 6 to 10°C by passing through a post cooling coil (either DX or chilled water based). This is a sensible cooling process as no moisture is removed. This cooled dry air is then pumped into the FBD through a high static blower to dry the wet yeast. Dried yeast is taken out from the bottom of the FBD, and humid air is exhausted to the atmosphere.

Figure 3: Skid mounted integrated dehumidification system

Figure 4: View of fluidized bed dryer

The desiccant rotor in the dehumidifier is continuously reactivated by passing hot ambient air in the reaction section as shown in *Figure 2*.

Conclusion

It is important to dry yeast for long term storage abilities. The most cost effective process to achieve it is by drying yeast using extremely dry low temperature air having 1.5 gram/Kg absolute moisture content at 6 to 10°C. As these conditions are not practically possible to achieve by only mechanical cooling, desiccant based integrated systems are used by various yeast manufacturers. ❖