DRYING

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Drying is one of the oldest and most common unit operations found in diverse processes. From ancient days onwards people dried fish, beef, potatoes, coco-nut, green peas, corn, paper, wood, palm seed, sunflower seed etc. Its importance not only to reduce the consumption of energy, but also to increase the productivity, to improve the product quality and quality control, to develop new products and new processes, safer and environmentally superior operation, etc.Drying is a complex phenomenon involving transient transfer of heat and moisture along with several rate processes, such as physical or chemical transformations, which, in turn, may cause changes in product quality as well as the mechanisms of heat and mass transfer. Drying usually occurs through two processes. In the first process, energy (heat) transfer from the surrounding to the wet solid can be due to convection, conduction, radiation or combination of any of these mechanisms. In the second process, internal moisture is transferred to the surface of the solid. In common practice, heat is transferred to the surface of the wet solid and then to interior. The first process depends on the external conditions such as temperature, air humidity and flow conditions, area of exposed surface and pressure. The 2ndprocess depends on, the movement of the internal moisture within the solid and this phenomenon is a function of physical nature of the solid, the temperature and its moisture content. The parameters on which 1st and 2nd process depends, act as the limiting factors governing the rate and total time of drying.



Importance of drying of moist object

Many physical, chemical and nutritional changes occur in moist objects during the drying process. Many of these changes arefunctions of temperature, moisture content and time. Therefore, undesirable effects should be better controlled, if the drying paramaters are predicted.Drying is needed for one or several of the following reasons: need for easy to handle free flowing solids, preservation and storage, reduction in cost of transportation, achieving desired quality of product, etc. In many processes, improper drying may lead to irreversible damage to product quality and hence an unusable product. its importance not only to reduce the consumption of energy, but also to increase the productivity, to improve the product quality andquality control, to develop new products and new processes, safer and environmentally superior operation, etc.

Methods of drying:

The following are the various drying methods: (i)Convective or direct drying: Convective air heating reduces air relative humidity, which is the driving force for drying.



(ii)Indirect or contact drying: It means that the heating through a hot wall, as drum drying, vacuum drying.



(iii)Dielectric drying:The heat is generated inside the moist material after absorbing the radiofrequency or microwaves andthat heat is transferred towards the surface. eg. Micro-oven drying.



(iv)Freeze drying: It is increasingly applied to dry foods, beyond its already classical pharmaceutical or medical applications. It can preserve the biological properties of proteins, and retains vitamins and bioactive compounds.



(v)Natural air drying: It takes place when materials are dried with unheated forced air, taking advantage of its natural drying potential. The process is slow and weather-dependent.



Applications of convective drying

The convective drying is used in the following industries for drying of various materials,

Agricultural and food industry:

The dehydration of fruits and vegetables prevents the growth and reproduction of micro-organisms as they will enhance decompose the food products. The microorganisms are almost inactive, when the moisture content is reduced to about 10%. And in food products, it is essential to reduce the moisture content below 5% in order to preserve flavour and nutrition. The systems utilize hot air to dry agricultural and food products take less drying time instead of conventional (natural convection) drying time. For food stuffs, flavor retention, palatability (pleasant or acceptable to the taste), reductions of micro biological reactions and protection from insects are important. So, the convective drying process is acknowledged as a better option for food industries to dry potato, apple, cassava, green peas, mango, onion, fish, pumpkin, broccoli stems, barley, oats, coffee, black pepper, biscuits etc.

Bio-oil industry:

In ancientdays products like peanuts, sunflower seeds, soybeans, rapeseed/canola and coconut were dried by open air drying system (natural convection). But, it needs high labor cost, high area requirement, lack of ability to control the drying process, vast drying time, non-uniformity in drying, possible degradation due to biochemical or micro biological reactions, insect infestation and so on. In order to get rid of those problems the convective drier is used in bio-oil industries.

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Building materials:

In the case of manufacturing of clay products like tiles and bricks, drying becomes very critical. Great care must be exercised in building materials because of the considerable strengthening and rigid that occurs in drying. In clay products, the water that used as a binding material must be removed in order to make the products sufficiently strong and rigid to withstand handling and setting in the kiln. If the product contains too much water, it will develop drying defects resulting in warping and cracking. The normal drying time of building materials is 7-12days or more in natural air drying. The convective drying system accomplishes this in 10 to 15 hour which results in substantial time savings as well as high product quality due to the uniformity of drying. Timber is retaining its strength and decorative properties after convective drying process. The clay products, clinker, tiles, brick, mortar and plaster of paris are also dried in this method.

Chemical/ceramic industry:

For many chemical industries the convective drying is used to determine moisture content requirements of bulk chemicals. The convective drying is used to dry the latex coating on fiberglass for fiberglass cord au tomobile tires. The coating is necessary to prevent the abrasion of the fiberglass. Also the convective drying is used to dry other ceramic materials like porcelain and pottery products.

Paper industry:

The largest demand for drying equipment is for the continuous drying of paper, which is done on convective dryers. The temperature and humidity conditions are important to the consistency of the paper. Here, initially the drying is achieved by convective drying and then dielectric drying is used to dry the coating materials on the paper as well as to dry the paper itself.

Textile industry:

Drying is also widely used in the textile industry for drying of textile packages, hanks, skeins, tops and loose stocks. Most convective textile dryers consist of a rotating drum called a tumbler through which heated air is circulated to evaporate the moisture from the load.

Nuclear waste disposal:

The nuclear waste is mixed with sugar and then calcined. Calcination (also referred to as calcining) is a thermal treatment process applied to ores and other solid materials in order to bring about a thermal decomposition, phase transition, or removal of volatile content. Calcination involves passing the nuclear waste through a heated, rotating tube. The purposes of calcination are to evaporate the water from the nuclear waste, and de-nitrate the fission products to assist the stability of the glass produced.