

# Investigation of Drying Efficiency for Laboratory Driers

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**Abstract-** Drying is an important mass transfer operation performed in various pharmaceutical and chemical industries. There are several types of drying equipment which can be operated at batch and continuous mode. Drying phenomenon and design of drying equipment holds lot of parameters which influence them but drying efficiency was found to be an important factor interrelating most of the other parameters of drying. Batch dryers like air tray dryer and hot air oven are taken for investigation of drying efficiency. Here the amount of moisture removed is increased with increase in time. Our study aims on examination of drying efficiency for batch dryers used in laboratory and to suggest a best dryer for laboratory use.

**Index terms-** batch dryers, dryer, drying, efficiency, laboratory

## I. INTRODUCTION

Solvent removal from a solid, liquid and semi-solids by means of evaporating phenomenon is described as drying which is a mass transfer operation. Convection is the most commonly used phenomenon occurs in this drying phenomenon. This mass transfer phenomenon occurs in last stage of production before packaging the materials. There are several drying methods available like contact or indirect drying, convective or direct drying, natural air drying, freeze drying, supercritical drying and dielectric drying. Surface moisture is evaporated by surrounding environment heat transfer. Drying is performed for following few purposes:

1. Material preservation by maintaining physico-chemical properties
2. Eliminate transportation issues such as weight.

Drying can be done for physicochemical and mechanical bounds and not for chemical bounds. In this process, heat and mass exchange occurs simultaneously. Materials physico-chemical properties are helpful in selection of conditions of drying like drying agent speed, temperature and

pressure. Chemical, woodworking, food-processing, leather, building-materials, paper and textile industries commonly use this drying phenomenon before drying. Common types of drying taking place in two different modes 1. Batch mode 2. Continuous mode.

### A. Batch Drying

A fixed quantity of product dried for a particular amount of time in a system. Drying is done for required moisture removal whose volume is fixed to dryer volume. After every batch, unloading of dried product is to be done and loading is to be done. Thus unloading and loading holds lot of time in batch dryer. In batch drying, there are two groups of classification namely static drying and mixing drying.

### B. Continuous drying

Flow of product into the dryer is continuous. It is economical in comparison with batch dryers. It offers flexibility as the system can handle lot of products. Here grain drying management knowledge is required for operating dryer at maximum efficiency. In continuous drying, there are two groups of classification namely static drying and mixing drying.

## II. MATERIALS AND METHODS

### A. Dextrin

Polymer mixtures of D-glucose linked by glycosidic bonds of  $\alpha$ -(1→6) or  $\alpha$ -(1→4). They belong to group of carbohydrates with lower molecular weight formed by starch or glycogen hydrolysis. Dextrin is brown, white or yellow in color which is completely or partly soluble. It finds numerous applications in food, pharmaceutical, textile, firework industries. As dextrin is raw material for various industries, we opted dextrin as a material to check the drying efficiency of laboratory dryers.

**B. Drying efficiency of Dryer**

Drying efficiency of a dryer is an important parameter to be analyzed while drying a product and in designing of drying equipments. Drying efficiency is calculated using the formula: Drying efficiency = (Initial weight of Product – Final weight of Product / Final weight of Product) \* 100

**C. Laboratory Dryers**

Laboratory dryers operating at batch mode are used for analyzing drying efficiency of dryer.

**1. Air Tray Dryer**

Air Tray Dryer is one of the best convectional drying process preferred. Our laboratory air tray dryer consist of large squared pipe like structure where a tray is placed in its middle. Air is made to flow into the dryer using a blower. Convection takes place inside the dryer. Heat coils are used to heat the air entering the chamber. Since it is a batch dryer, loading and unloading of product is to be done after every process.

**2. Hot Air Dryer**

Hot air dryer finds numerous applications in various chemical, biological, pharmaceutical experiments. As from the name, hot air is used for drying the product. It also finds an additional advantage of product sterilization compared to other dryers. It is rectangular chamber in which the product is placed in the chamber plate. Hit air is made to flow for a period of time and drying phenomenon can be analyzed.

**D. Procedure**

25 g of dextrin sample is taken and mixed with 20 ml of water and placed in trays of air tray dryer and hot air dryer. Heating coils were heated and temperature is maintained at 50°C. Constant air flow is maintained and weight of sample is checked for regular interval of time and drying efficiency is compared for the dryers.

**III. RESULTS AND DISCUSSION**

**A. Air Tray Dryer**

Time (in minutes)	Weight of sample (in grams)
0	43.5
12	42.8
24	41.3
36	40.2

48	39.5
60	37.9
72	36.6
84	35.4
96	34.7
108	33.5

Table. 1 Air Tray Dryer

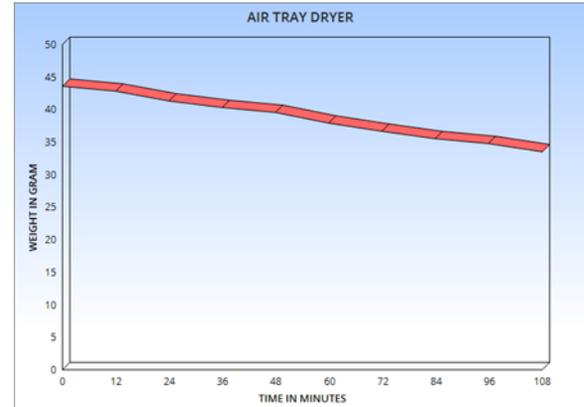


Fig. 1 Air Tray Dryer Graphical Representation

**B. Hot Air Dryer**

Time (in minutes)	Weight of sample (in grams)
0	43.5
12	42.9
24	41.1
36	40.4
48	39.7
60	38.3
72	37.8
84	36.6
96	35.4
108	34.6

Table. 2 Hot Air Dryer

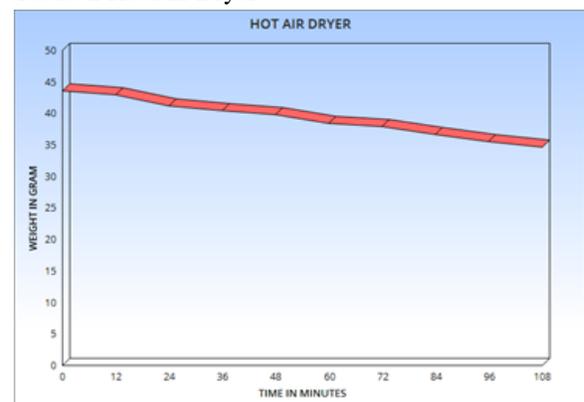


Fig. 2 Hot Air Dryer Graphical Representation

### C. Drying Efficiency

Analyzing the data from Table 1 and Table 2, it is found that drying occurs well in air tray drier than hot air dryer. In a period of 108 minutes, moisture of 9.5 g left in air tray dryer and 10.6 g left in hot air dryer. Thus we can conclude that air tray dryer efficiency is higher than hot air dryer efficiency. Drying efficiency is concluded by moisture removal percentage.

Percentage of moisture removal from air tray dryer = 51.28%

Percentage of moisture removal from hot air dryer = 45.64%

### IV. CONCLUSION

Industries like chemical, pharmaceutical and food industries use dryers for drying their product before packaging. Batch dryers are used in many small and medium scale industries for performing drying mass transfer operations. Efficiency of drying is an important factor to be considered while choosing drying parameters. Dextrin was used to analyze the drying efficiency. On analyzing drying efficiency of hot air dryer and air tray dryer at a temperature of 50°C, it is found that air tray dryer exhibits a greater efficiency of drying than hot air dryer. So it is suggested to use an air tray dryer than hot air dryer in small and medium scale industries at 50°C for powdered materials.

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