FORCED DRAFT TRAY DRYER

MODEL NO - AEC321

Instruction Manual

ATICO EXPORT.
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Foreword

Welcome to a value-conscious company, "**ATICO**". We are proud of the advanced engineering and quality construction of our each equipment.

This manual explains the working of equipment. Please read it thoroughly and have all the occupants follow the instructions carefully. Doing so will help you enjoy many years of safe and trouble free operation.

When it comes to service remember that "**ATICO**" knows your equipment best and is interested in your complete satisfaction. We will provide the quality maintenance and any other assistance you may require.

All the information and specifications in this manual are current at the time of printing.

However, Because of "**ATICO**" policy of continual product improvement we reserve the right to make changes at any time without notice.

Please note that this manual explains all about the equipment including options. Therefore you may find some explanations for options not installed on your equipment.

You must follow the instructions and maintenance instructions given in the manual carefully to avoid possible injury or damage. Proper maintenance will help ensure maximum performance, greater reliability and longer life for the product.

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FORCED DRAFT TRAY DRYER

OBJECTIVE:

- Drying of solids in a tray dryer under forced draft tray condition.

AIM:

- To determine the drying rate of a solid under forced draft condition and determine the critical moisture content.

INTRODUCTION:

In many cases, drying of materials is the final operation in the manufacturing process, carried out immediately prior to packaging or dispatch. Drying refers to the final removal of water, and the operation often follows evaporation, filtration or crystallization. Drying is carried out for one or more of the following reason:

- To reduce the cost of transport.
- To make a material more suitable for handling.
- To provide definite properties.
- To remove moisture this may otherwise lead to corrosion.

THEORY:

Drying of solids is considered to occur in two stages, a constant rate period followed by a falling rate period. In the constant rate period, the rate of drying corresponds to the removal of water from the surface of the solid. The falling rate period corresponds to the removal of water from the interior of the solid. The rate in either case is dependent on:

- Flow rate of air.
- The solid characteristics.
- Tray material.

The rate of drying can be determined for a sample of substance by suspending it over an electronic balance in the duct, in a stream of air, from a balance. The weight of the drying sample can then be measured as a function of time. Certain precautions must be observed if the data are to be of maximum utility. The sample should not be too small. Further, the following conditions should resemble closely as possible those expected to prevail in the contemplated large-scale operation:

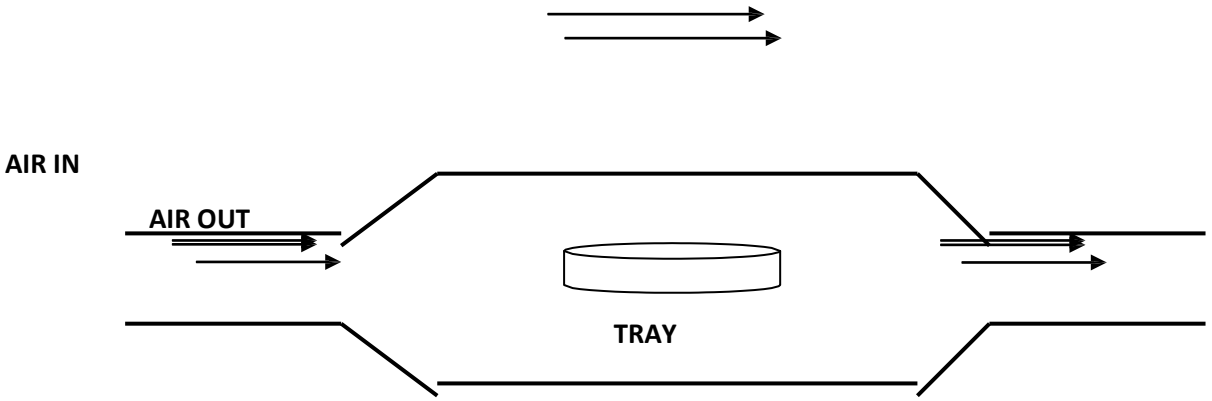
- The sample should be similarly supported in a tray or frame.
- It should have the same ratio of drying to non-drying surface.
- It should be subjected to similar conditions of radiant heat transfer; and
- The air should have the same temperature, humidity and velocity(both speed and direction with respect to the sample).

If possible, several tests should be made on samples of different thicknesses. The dry weight of the sample should also be obtained. The drying rate is calculated from:

$$N = -S\frac{dx}{d\theta}\frac{1}{A}\left(\frac{kg}{m^2 s}\right)$$

DESCRIPTION:

- A schematic diagram of the experimental set-up is given below:



It is a wind-tunnel type tray dryer. The main components are;

- Drying chamber
- Air blower
- Heater
- Orifice in the air duct
- A tray
- Balance

The air flow is controlled by a valve in the blower outlet and its flow rate is measured by a pre-calibrated orifice meter. Thermometers are placed at the inlet and outlet of the drying chamber.

UTILITIES REQUIRED:

- Electricity Supply: 1 Phase, 220V A.C, 2.5kW Wet Solid
- Floor area 1m × 2m
- Saw Dust

EXPERIMENTAL PROCEDURE:

- Load the pre-weighed tray with solid and record the weight of sand & tray.
- Start the blower and heater. Fix the air flow rate and let the system to achieve steady state as the air flow rate would make the temperature steady.
- When the desired conditions of temperature and air velocity are reached(in about 10-15min), remove the sample tray and put known amount of water in it to give desired initial moisture content.
- Place the tray gently in the drying chamber and start the stopwatch.
- Record the balance reading with time at about 3-5min time interval.
- Drying is assumed to be complete when at least 3 consecutive readings are unchanged.
- The temperatures at the inlet and outlet of the drying chamber and the air flow rate(manometer reading fixed across the orifice) are recorded at least three times during the course of run to give average operating conditions.
- The same steps are repeated for other runs at different operating conditions.

  The range of variables may be fixed as given below:

  Air Flow rate = 8 to 10 cm manometric difference(with water as manometric fluid)

  Initial Moisture Content = 20-50% (Prepare the sample in this range of moisture content)

CALCULATION FORMULAE:

Moisture content present in solid, X(kg water/kg dry solid) X
= (W-S)/S

The drying rate is thus calculated from:

$$N = -S\frac{dx}{d\theta}\frac{1}{A}\left(\frac{kg}{m^2 s}\right)$$

$$N = -\frac{S}{A}\frac{\Delta x}{\Delta \theta}$$

OBSERVATIONS & CALCULATIONS:

Tray diameter = 150mm

Surface Area of Solid = 0.0706m2

Solid dry wt. = Initial

Moisture content =

Manometric difference, R = m

$$h = R \times \left(\frac{\rho_m}{\rho_a} - 1\right)$$

Superficial air flow rate , $G = 0.61 \times a_o \times \sqrt{2gh} \times \rho_a \ kg/m^2s$

S. No.	Time, θ sec	Wt. of solid (Solid + water) , Kg	X=(W-S)/S(Kg water/kg dry solid)	$N = \frac{S}{A}\frac{\Delta x}{\Delta\theta}$

Plot X Vs θ and draw a straight line through all points. Fit a second degree polynomial to the X Vs θ data and obtain the slope dX/dθ corresponding to various values of θ

The drying rate is thus calculated from:

$$N = -S\frac{dx}{d\theta}\frac{1}{A}\left(\frac{kg}{m^2 s}\right)$$

$$N = -\frac{S}{A}\frac{\Delta x}{\Delta\theta}$$

Plot drying rate N (kg/m^2-s)Vs moisture content X (kg of water/kg of dry solid). From this plot critical moisture content (X_C) can be obtained.

The experiment can be repeated at constant air flow rate and constant air temperature.

NOMENCLATURE:

A	=	Dying surface area, m^2
G	=	mass velocity of gas, kg/m^2-s
N	=	drying rate, kg/m^2-s
N_c	=	constant drying rate, kg/m^2-s
S	=	mass of dry solid, kg
T_g	=	absolute temp. of gas (dry bulb), K
X	=	moisture content of solid (kg of water/kg of dry solid)
Θ	=	time, sec
P	=	density, kg/m^3
P_m	=	density of manometric fluid, kg/m^3
P_a	=	density of air, kg/m^3
a_0	=	area of orifice, m^2
W	=	mass of wet solid, kg

PRECAUTIONS &MAINTENANCEINSTRUCTIONS:

- Measure the exact volume of water and weigh the Mixture.
- Always use clean water and good quality saw dust for mixing.
- Use electronic balance for weighing of mixture.
- Keep close the front door if chamber while working.
- Don't ON heater switch before putting the mixture in chamber.

TROUBLESHOOTING:

- If D.T.C display '1' on display board it means sensor connection is not OK tight that.
- If switch ON the heater but temperature can't rise but panel LED is ON it means there is any fault in panel ask electrician or us