CERAMICS MATERIALS MANUFACTURING

Dr.Alaa Aladdin

GREEN BODY DRYING

INTRODUCTION

body fabrication process different solvents are used.

LUBRICANT ADDITION

This flow emanates from the rearrangement of particles in the green body, which is caused by the compressive capillary pressure at the surface of the green body.

At some point, the particle network becomes rigid and no more shrinkage can take place.

Section 6

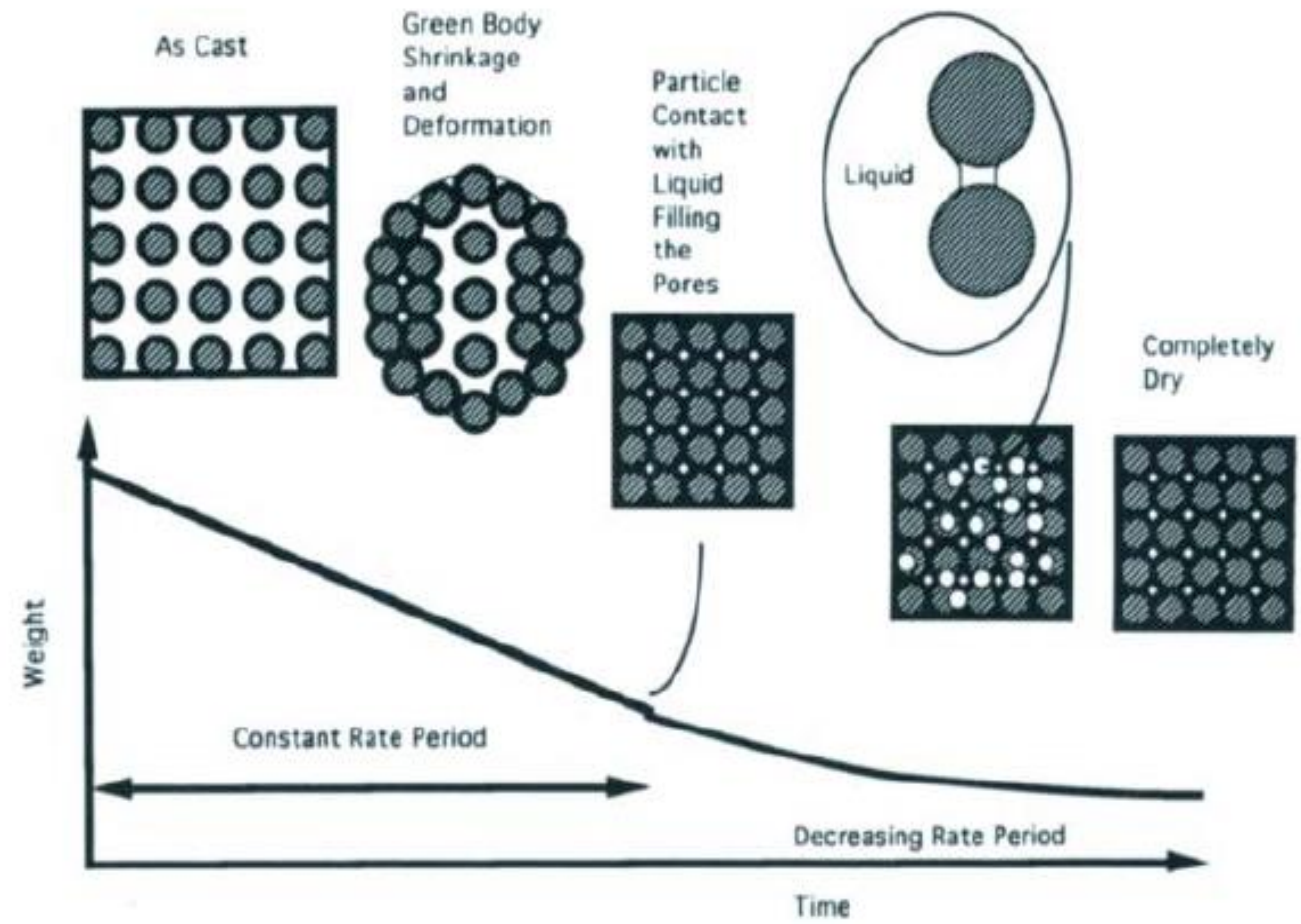

FIGURE .1 diagram of the drying of a ceramic green body showing the weight loss and shrinkage with time

LUBRICANT ADDITION

rigidity threshold

surface of all the ceramic powder.

Such capillary flow will continue as *long as there* is a **continuous pathway from the liquid front to the green body surface**.

LUBRICANT ADDITION

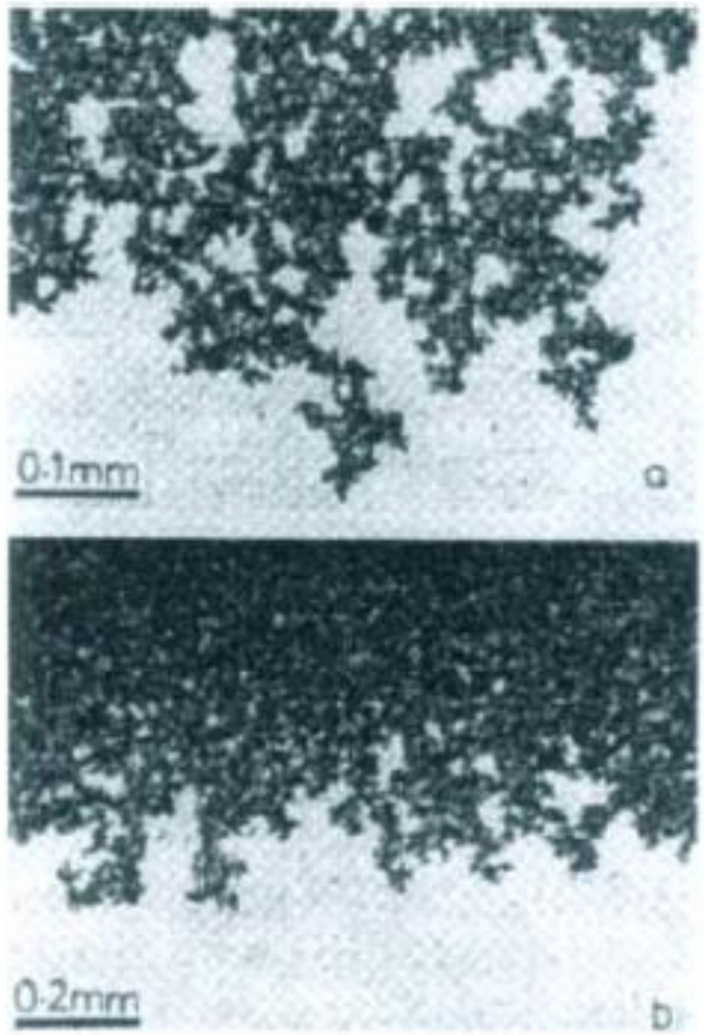

FIGURE 2 The drying front in a green body composed o
f mono sized 0.5 mm SiO_2 particles

TABLE .1 List of Polymers That Depolymerize during Thermal Degradation

Polymer	*Volatiles Monomers (%)*	*T(°C)*	*Mechanism*
Methylmethacrylate	100	275 + 340	EI + CS
Methyl-α-phenylacrylate	45	—	RI + CS
n-Butylmethacrylate	50	250	EI + CS
Styrene	45[b]	>300	WLS
α-Methylstyrene	45	—	RI + CS
Acrylic acid	45	350	RI + CS

DRYING MECHANISM
(DRYING PROCESS)

exposed to the bulk gas at temperature T_B, and
h is the heat transfer coefficient which is a function of the gas flow rate around the green body.

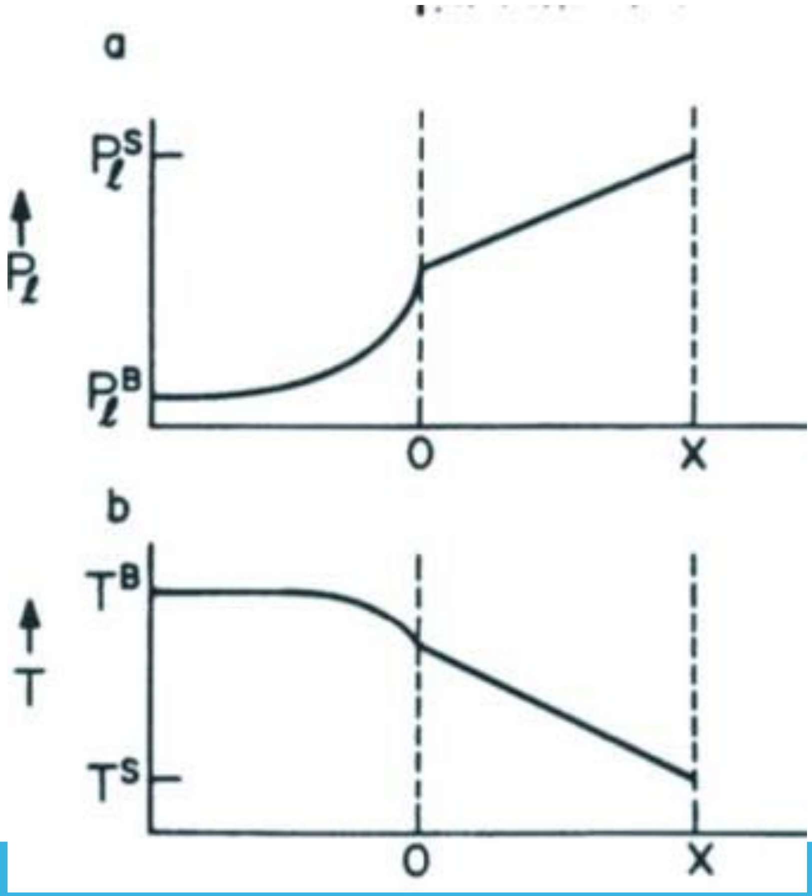

FIGURE .3 diagram of evaporation in a porous network (a) liquid partial pressure profile, (b) temperature profile.

$$q = \Delta H_{\mathbf{vap}} * j$$

This relation requires that the two differential equations for the two fluxes be linked for their simultaneous solution, the mass transfer flux **j**.

DRYING RATE

$$\theta_d = \int_{w_1}^{w_2} \frac{dw}{R_d}$$

The drying time q_d , drying rate R_d, water content w

STAGES OF DRYING

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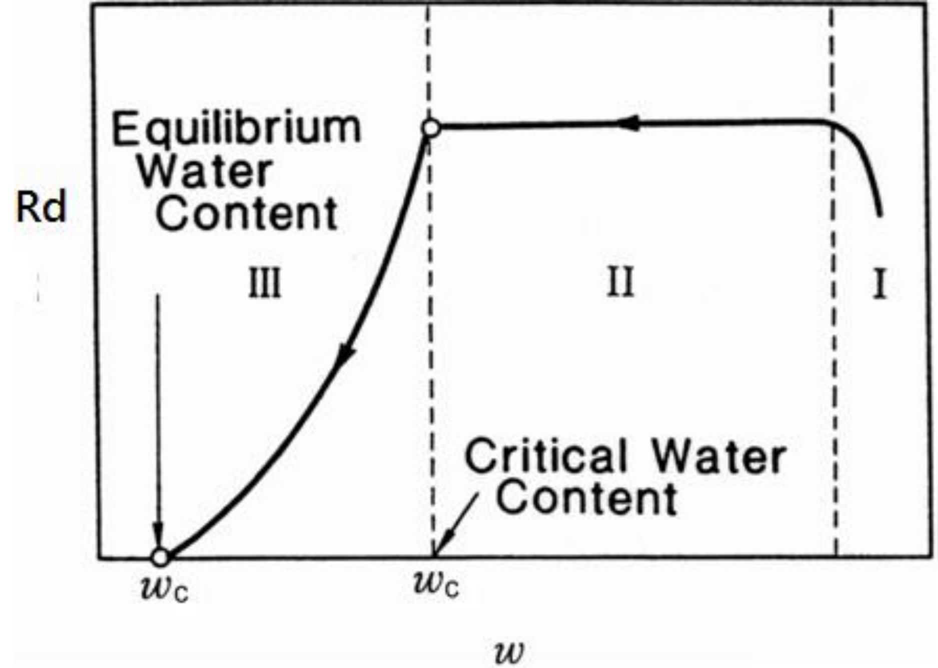
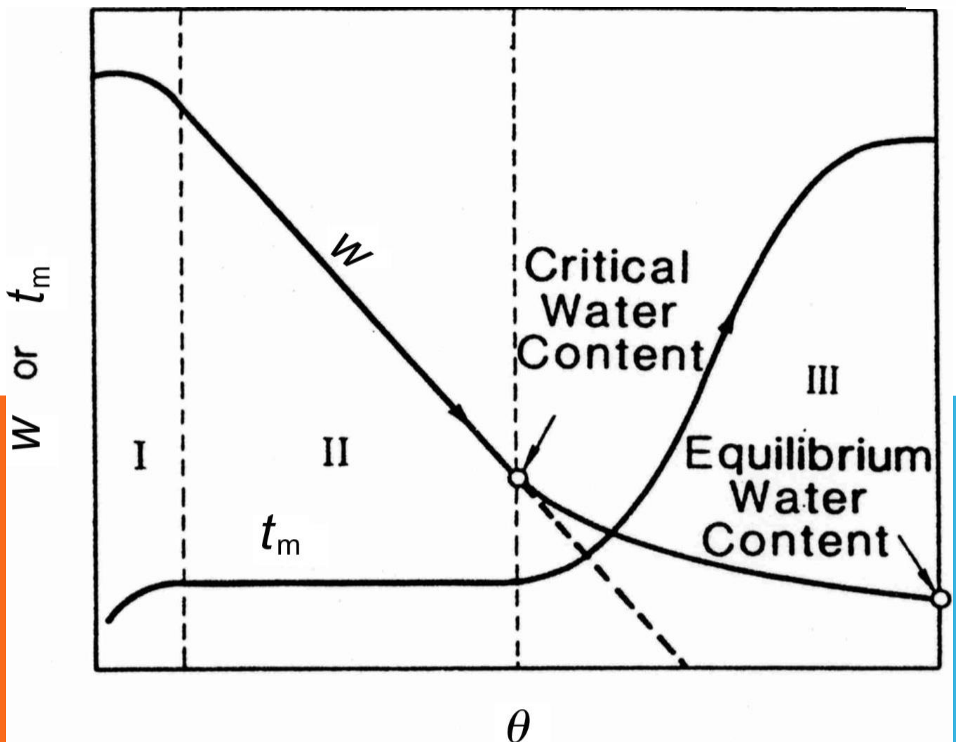
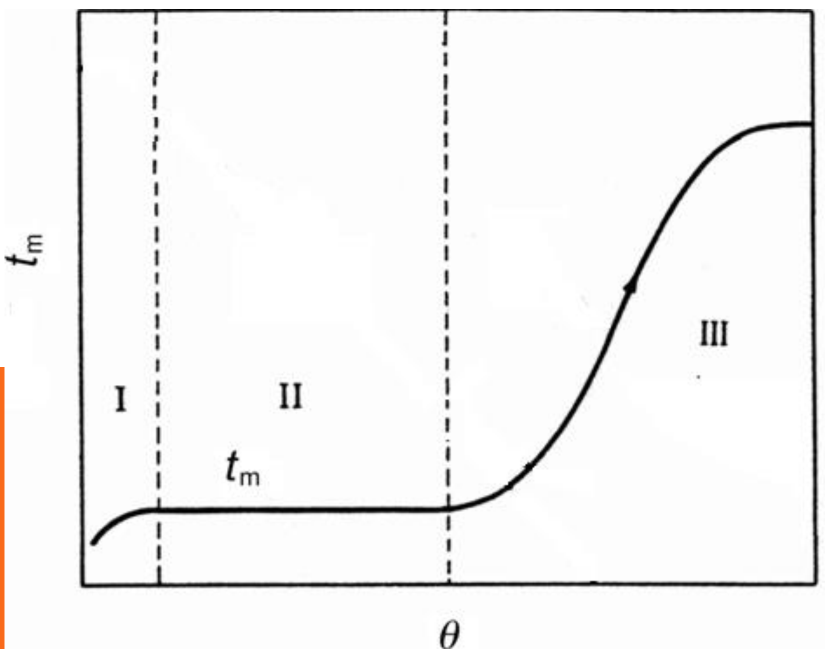
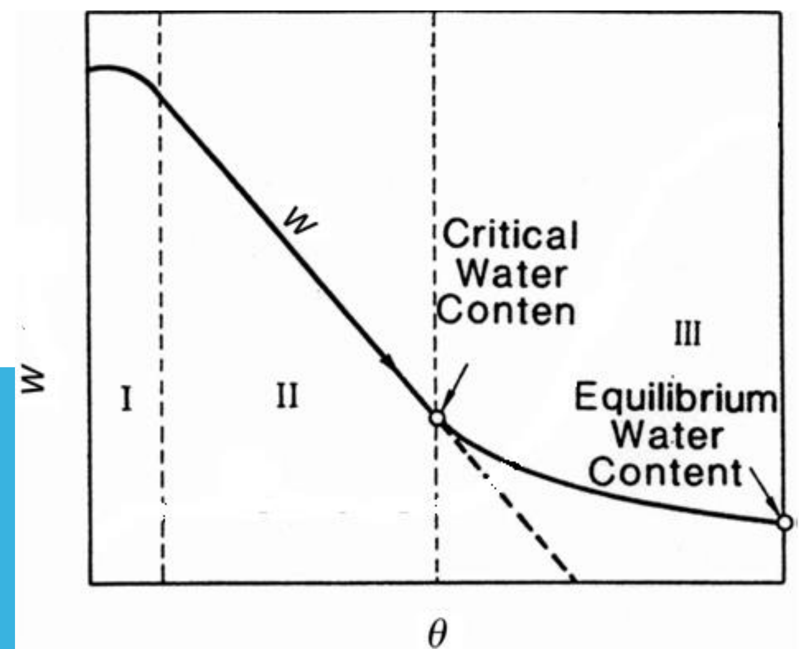




STAGES OF DRYING





DRYING STRESSES

$$\langle \sigma \rangle = \frac{1}{V_p} \int_0^{V_p} \sigma_e \, dV$$

The stress within the solid is often to be **constant** over the green body, thus it disappears from the net stress.

If, however, there is a temperature profile in the green body.

DRYING STRESSES

gradients .

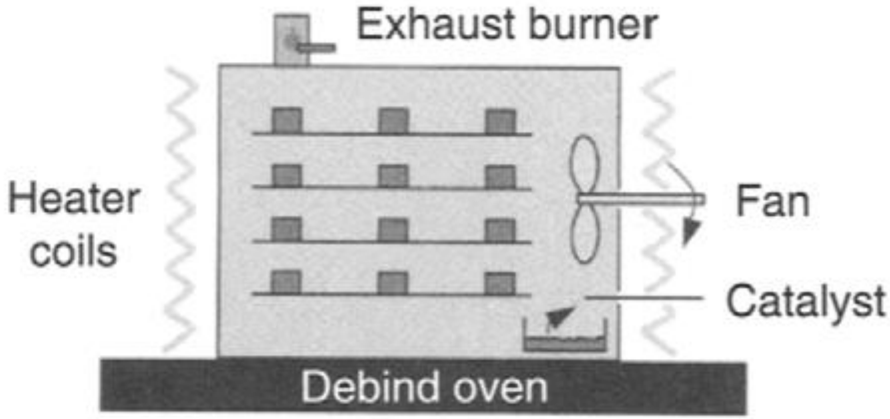
- relieved by flow if the permeability of the particle network is high.

CRACKING, AVOIDANCE OF CRACKING

selected to prevent cracking of the green body.

CRACKING, AVOIDANCE OF CRACKING

CRACKING, AVOIDANCE OF CRACKING



The vapors are condensed by passing them through **a distillation column** and reused. Solvent and thermal debinding are slow **(10 to over30 h)** processes, but catalytic debinding is faster and usually takes **2-4 hours for** completion.

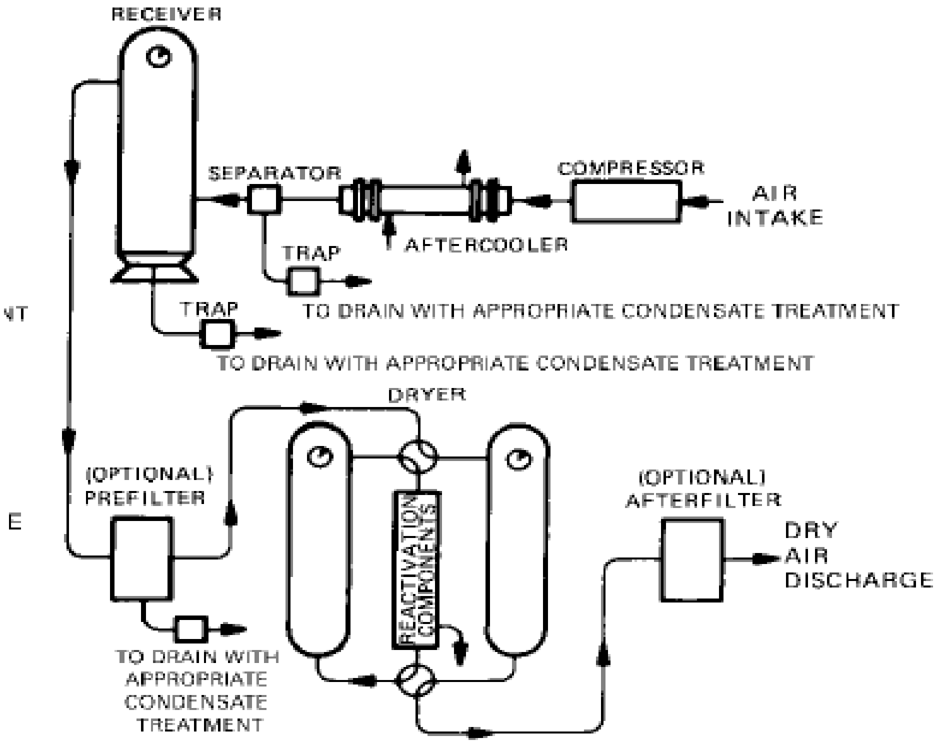
Large, bulky parts present considerable difficulty in binder removal and are not good .

QUANTITY OF HOT AIR REQUIRED FOR DRYING PROCESS,

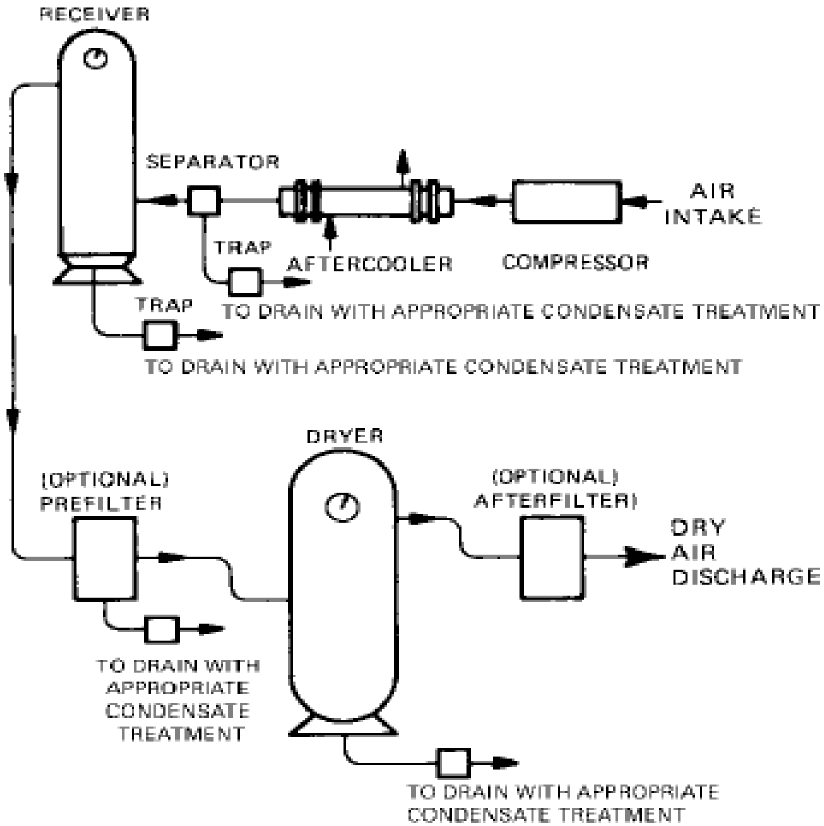
Section 6

TYPES OF COMPRESSED AIR for DRYERS

- **Regenerative Type**
- **Single Tower Type**
- **Membrane Type**



COMPRESSED AIR DRYING SYSTEM
DESICCANT REGENERATING DRYER

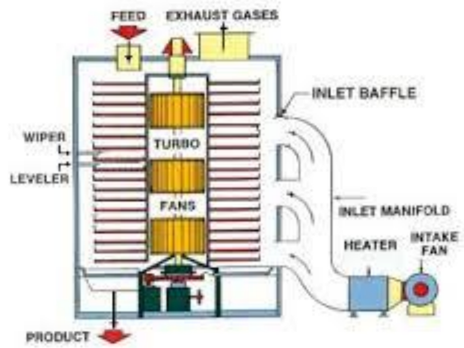


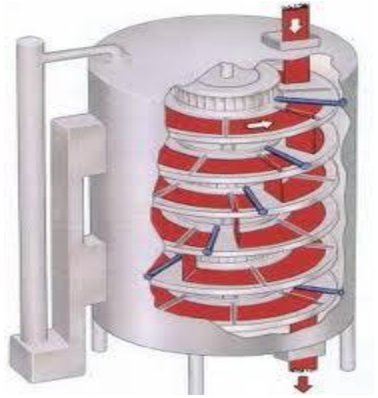
COMPRESSED AIR DRYING SYSTEM
DELIQUESCENT DRYER

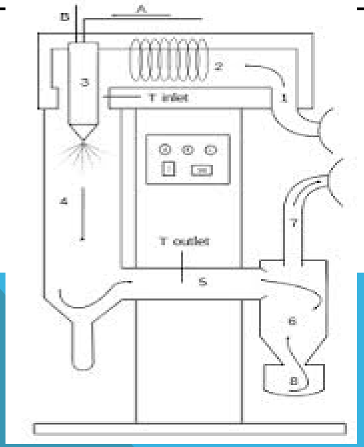
Refrigerant

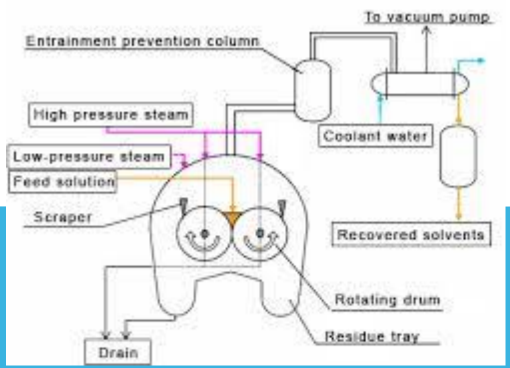
Single Tower Deliquescent

TYPES OF DRYERS









Spray dryer

Drum dryer

TYPES OF DRYERS

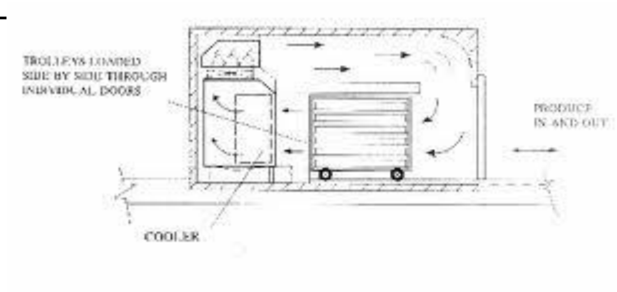
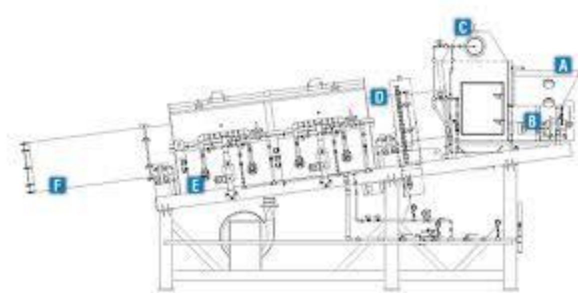
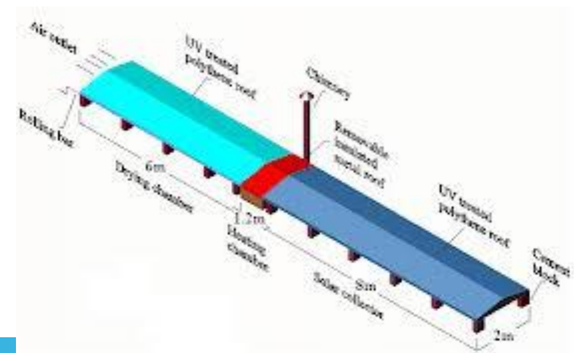


Figure 9 Batch-continuous air blast freezer with crossflow air circulation





Rotary dryer	Continuous tunnel dryers