

Example 2. Determine the boiling point, and freezing point of 18 M lithium chloride solutions.

Solution. From Table 1, boiling point (standard) is 285.8 F, freezing point is 58.1 F.

Example 3. Calculate the heat of vaporization of 1 lb of water from a large amount of 18 M lithium chloride solution at the boiling point.

Solution. The heat of boiling is equal to the heat of mixing plus the heat of boiling pure water at the same temperature. The heat of mixing from Table 1 at 18 M and 285.8 F is $145 - (0.186 \times 285.8) = 92$ Btu per pound. The heat of vaporization of water from steam tables at 285.8 F is 920 Btu per pound. Therefore the heat of vaporization of water from the solution is $920 + 92 = 1012$ Btu per pound.

Example 4. One thousand pounds of air per minute at 100 F dry-bulb with a dew-point of 70 F and a relative humidity of 39 per cent are passed over 18 M lithium chloride solution. The rate of flow of the solution is 200 gpm and the entering temperature is 80 F. The air leaves the absorber at 85 F dry-bulb and dew-point of 35 F. Calculate

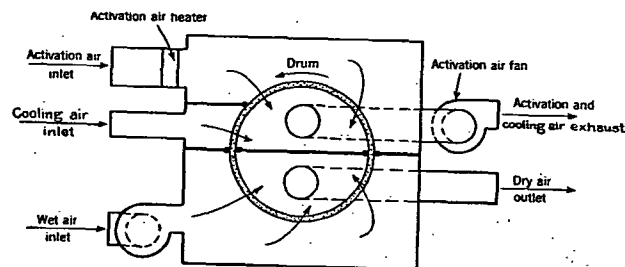


FIG. 4. SOLID ADSORBENT DEHYDRATOR—ROTATING BED TYPE

(a) the heat to be removed from the lithium chloride solution to maintain these conditions, and (b) the temperature rise of the solution in passing through the absorber.

Solution. (a) The enthalpy of the entering air at 100 F dry-bulb and 39 per cent relative humidity $= h_a + \mu_{as} = 24.00 + (0.39 \times 47.40) = 42.49$ Btu per pound (Table 6, Chapter 1).

The relative humidity of the air leaving at 85 F dry-bulb and 35 F dew-point is 16.7 per cent (psychrometric chart). Enthalpy of leaving air $= 20.39 + (0.167 \times 28.85) = 25.21$ Btu per pound (Table 6, Chapter 1).

Heat to be extracted from air $= 1000 (42.49 - 25.21) = 17,280$ Btu per minute. Heat of mixing $= 145 - (0.186 \times 80) = 130$ Btu per pound of moisture removed. From Table 6, Chapter 1, the moisture removal per pound of air $= 0.01574 - 0.00426 = 0.01148$ lb. Heat of mixing for 1000 lb of air $= 1000 \times 0.01148 \times 130 = 1492$ Btu. Total heat extraction $= 17,280 + 1492 = 18,772$ Btu per minute.

(b) The weight of solution circulated is 200×1.27 (Table 1) $\times 8.33 = 2116$ lb per minute. Its heat capacity $= 2116 \times 0.631$ (Table 1) $= 1335$ Btu per minute per degree Fahrenheit. The temperature rise $= 18,772 \div 1335 = 14.1$ F.

SOLID DEHYDRATION METHODS

One type of equipment suitable for producing dehydration with solid drying agents utilizes an apparatus with continuous operating rotating beds or dampers as illustrated in Fig. 4. The apparatus consists essentially of a cylinder or drum filled with dehydrating material. Air flow

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through the drum is directed by baffles which permit three independent air streams to flow through the adsorbing material. One air stream consists of the wet air which is to be dehydrated. The second is heated activation air used for drying that part of the dehydrating material which has become saturated. The third air stream cools the bed to a temperature below 150 F to permit pickup of moisture when that part of the bed returns to the dehydration cycle.

In the rotating bed apparatus, the baffle sheets are stationary and the screened bed rotates at a definite speed to permit the proper time of contact in the activation, cooling and dehydration cycles. In the rotating

TABLE 3. DENSITY OF LITHIUM CHLORIDE SOLUTIONS

CONCENTRATION POUND MOLS (42.4 LB) LiCl PER 1000 LB WATER	TEMPERATURE DEG F						
	0	50	100	150	200	250	300
0							
2		1.045	1.037	1.026	1.012		
4	1.090	1.085	1.076	1.064	1.052		
6	1.124	1.119	1.111	1.100	1.087		
8	1.156	1.150	1.143	1.132	1.122		
10	1.188	1.181	1.172	1.162	1.152	1.142	
12	1.217	1.209	1.199	1.188	1.178	1.168	
14	1.242	1.235	1.225	1.214	1.203	1.192	
16		1.257	1.248	1.236	1.226	1.215	
18		1.279	1.270	1.259	1.248	1.237	
20			1.291	1.280	1.279	1.568	
22				1.310	1.289	1.278	1.267
24				1.317	1.307	1.296	1.286
26					1.313	1.312	1.302
28					1.338	1.327	1.318
30						1.34	1.33
32							1.35

damper apparatus, the bed remains stationary and a sectionalized damper rotates. This rotating damper produces the same general effect as if the stationary baffles previously mentioned rotated.

Clean air for activation is supplied at temperatures normally ranging from 300 to 350 F. Any source of clean heated air can be used such as air heated by electric heaters or steam coils, or air indirectly heated by coal or oil fired interchangers. Direct fired heaters are usually designed for gas since there must be no condensable fatty combustion products to contaminate the adsorbent. To avoid excessive contamination or clogging of the adsorbent bed by dust it is frequently desirable to provide filters for the activation air.

Where activation air heating coils are supplied with steam at 80 lb per square inch gage pressure or higher, activation efficiency will remain normal and moisture removal capacity will not be reduced. When lower steam pressures are used, incomplete reactivation will result in reduced moisture removal.