

Chemical Engineer's Solutions Suite

Platform: Windows
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This Mathcad electronic book is a rendering of selections from Hick's Standard Handbook of Engineering Calculations by McGraw-Hill. Solve hundreds of applied problems in chemical and process engineering with this practical electronic resource which contains more than 180 relevant formulas and equations from the book, as well as text, tables, graphs and diagrams. This fully-interactive CD-Rom supplies you with all the tools you need to find the right equation and solve a problem in an instant.

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CHEMICAL ENGINEER'S SOLUTIONS SUITE

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ANALYSIS OF A SATURATED SOLUTION

Calculation Procedure:

1. Compute the precipitate when the solution is cooled

When a solid is dissolved in water (or any other solvent liquid), the resulting solution is termed saturated when at a given temperature the solvent cannot dissolve any more of the solid. Most solvents dissolve (hold) more solids at higher temperatures than at lower temperatures. Thus, when the solution temperature is lowered or a portion of the solvent is evaporated, the solution becomes supersaturated and solid material may precipitate. This is the basis of crystallization, a chemical engineering operation frequently used to produce a product.

Referring to Fig. 1, obtain these solubilities: at 80°C (176°F) KClO₃ solubility = 10.5 g per 100 g of H₂O.

The weight of the water at 80°C (176°F) = (1000 g/kg). Now, the weight of KClO₃ that any solvent can dissolve at this temperature, lb (solubility of KClO₃ at the given temperature) × (8103 lb of water) = (8103) × (10.5 g per 100 g) = 851 lb (386.8 kg) of KClO₃ dissolved in the water.

When the temperature of the water (solvent) is reduced to 30°C (86°F) with the same quantity of water but the solubility of KClO₃ is only 10.5 g per 100 g of H₂O, the weight of KClO₃ dissolved at 30°C (176°F) - weight of KClO₃ precipitated.

Note that the same procedure can be followed for any other solid need be the ones considered here.

2. Compute the precipitate when a portion of the solvent is evaporated

Since half the solvent (water in this case) is evaporated, the weight of KClO₃ dissolved at 30°C (176°F) - weight of KClO₃ precipitated = 4051.5 (57 g KClO₃ per 100 g H₂O) = 2597.0 (191.5 kg) of KClO₃. Then the weight of KClO₃ precipitated = 851 - 2597.0 = 1746.0 (791.8 kg) of KClO₃.

Fig. 1 - Solubility of KClO₃.

Temperature (°C)	Temperature (°F)	Solubility (g/100g H ₂ O)
0	32	3.3
10	50	5.0
20	68	7.1
30	86	10.5
40	104	14.0
50	122	18.0
60	140	23.0
70	158	29.0
80	176	36.0
90	194	44.0
100	212	53.0

Source of data: Perry

The Chemical Engineer's Solutions Suite includes topics such as chemical mixing, batch processing, pumps, piping, steam transmission, energy savings, waste heat, gas and vapor disposal, separators, and storage tanks

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