

Solubilizing SMA® Resins In Water

SMA® Resins are soluble in water at basic pH as are their polycarboxylate salts. Solid SMA® resins, in flake or powder form, can be solubilized in water by reacting with an alkaline material, such as sodium or potassium hydroxide, or an amine, such as ammonium hydroxide, methylamine or monoethanolamine.

It is recommended that any new process should be performed first on a lab scale to determine characteristics for that particular reaction, such as dissolution rate and reaction exotherm.

Typical Solubilization Procedure:

1. Charge reactor with room temperature water.
2. Start agitation. Add solid SMA® Resin so as to give a fully wetted, uniform slurry. SMA® Resin powder is easier to slurry than SMA® Resin flake, and has a faster dissolution rate due to its higher surface area.
3. Add alkali or amine reactant to the stirred slurry. The formula following this procedure can be used to calculate the amount of reactant to be used. This step is typically accompanied by a mild temperature exotherm, which can be controlled by rate of addition. If the reactor is so equipped, addition of ammonium hydroxide solution below the liquid surface minimizes ammonia vapor loss. Amine reactants can be added as a neat liquid, or as a water solution. Addition of concentrated water solutions of sodium or potassium hydroxide is recommended over addition of these reactants in pellet or flake form.

4. While a solution can be formed by stirring at room temperature, heating the solution will speed up the dissolving time greatly. A reaction temperature of 60-70 °C is recommended for ester grades (1440, 2625, 17352), and 80-90 °C is recommended for base resin grades (1000, 2000, 3000, 4000). Higher temperatures can be used, particularly when using a pressurized reactor, but high reaction temperatures for extended periods of time may give a darker color to the product solution. Care must be exercised in heating reactions involving SMA® 1440, since the low softening point of this resin grade can sometimes lead to agglomeration in the reactor before dissolution takes place. Finally, high speed mixing should be avoided, since entrained air can cause foaming. Typical reaction times range from 1 to 5 hours, depending upon solution concentration, resin grade and degree of mixing.
5. After dissolution is complete, adjust pH if needed. The pH of the product solution must be basic, neutral pH or lower will cause solid formation or gelling of the solution. A typical pH for solutions prepared using amines would be 8 or above, while a typical pH for solutions prepared using alkali would be 10 or above.

General Formula:

For calculating the amount of amine or alkali to add to the dissolving reaction, referred to in step 3 of the above procedure:

$$\frac{(\text{amine or alkali mol. wt.}) \times (\text{SMA acid no.}) \times (\text{wt. SMA}) \times (\text{excess factor})}{56,100 \times (\text{amine or alkali concentration, as a decimal})}$$

= weight amine or alkali

Frequently, 5 to 15 % excess amine or alkali is used in the solubilizing reaction to speed dissolution, or, in reactions involving volatile amines, to compensate for vapor loss. In these cases, the excess factor referred to in the general formula would be 1.05 to 1.15.

Sample Calculation:

How much 28% ammonium hydroxide solution would be used to prepare 1000 lbs. of a 20% SMA[®] 1440 solution, using 10% excess base?

In the general formula: The molecular weight of ammonia is 17, the acid number of SMA[®] 1440 is 175, the weight of SMA[®] 1440 would be 200 lbs. (20% of 1000 lbs.), the excess factor is 1.1 and the amine concentration is 0.28, giving:

$$\frac{(17) \times (175) \times (200) \times (1.1)}{56,100 \times (0.28)} = 41.7 \text{ lbs. of 28\% ammonium hydroxide solution}$$

Therefore, the charges for this reaction would be:

SMA [®] 1440	200 lbs.
Water	758.3 lbs.
28% Ammonium Hydroxide	<u>41.7 lbs.</u>
	1000 lbs.

Frequently Used Values:

<u>SMA Resin Grade</u>	<u>Acid Number</u>
1000	480
2000	350
3000	275
1440	175
17352	270
2625	220

Molecular Weights:

Ammonia	17.0
Methylamine	31.0
Monoethanolamine	61.0
Dimethylaminoethanol (DMAE)	89.1
Aminomethylpropanol (AMP)	89.1
Sodium Hydroxide	40.0
Potassium Hydroxide	56.1

Maximum Recommended Percent Solids:

<u>SMA Resin Grade</u>	<u>Ammonium Salt</u>	<u>Sodium Salt</u>
1000	38	40
2000	25	35
3000	15	25
1440	35	25
17352	25	25
2625	20	25