

How to Disperse an Aqueous Alcohol-Based INVIZ™ Solution in Water

INVIZ™ is soluble in a certain range of aqueous alcohol solutions but is only slightly soluble in water at pHs lower than 12. However INVIZ™ dispersions can be made in water by slowly adding an aqueous alcohol based INVIZ™ solution (that has either a high pH or a low pH) to water and allowing the alcohol to evaporate over time with stirring.

A. Safety

- 1) Safety glasses
- 2) Adequate ventilation
- 3) Refer also to your institution's internal lab safety guidelines

B. Chemicals

- 1) Solution of INVIZ™ in aqueous alcohol according to "How to Dissolve INVIZ™ in Aqueous Alcohol." For this application the solution may be up to 20% mass INVIZ™ to mass aqueous alcohol.
- 2) Cold water
- 3) Acid or base for pH adjustment (Ex. 6 N hydrochloric acid or 50% (w/w) aq sodium hydroxide)
- 4) Plasticizer (optional). A list of INVIZ™ plasticizers is available upon request. (Ex. propylene glycol) Plasticizers may assist with film forming and may reduce chalky appearance of the dried dispersion.

C. Equipment

- 1) Graduated cylinder
- 2) Flask or similar container
- 3) Explosion proof mixer or stirrer
- 4) pH meter
- 5) Syringe pipette
- 6) Balance / scale (if plasticizer is used)
- 7) Moisture balance or oven (if plasticizer is used)
- 8) 1-5 mL macropipette (if plasticizer is used)

D. Procedure

- 1) Step one
 - a) Follow the procedure "How to Dissolve INVIZ™ in Aqueous Alcohol" to make an appropriate solution. (Ex. 5.0 g INVIZ™ dissolved in a 100 g of 70% (w/w) aqueous ethanol solution.)
- 2) Step two
 - a) Using the pH meter, adjust the pH of the solution.
 - If a pH of ~4.9 or lower is desired, using a disposable pipette, add drops of acid (Ex. 6 N HCl) until the desired pH is reached.
 - If a pH of ~9.5 or higher is desired, using a disposable pipette, add drops of base (Ex. 50% (w/w) aq NaOH) until the desired pH is reached.
 - Between pHs of ~4.9 and ~9.5, INVIZ™ dispersions in water tend to agglomerate over time making them inappropriate for many applications.

- 3) Step three
- Measure out a volume of cold water equal to the volume of an aliquot of the pH adjusted INVIZ™ solution (ex. 100 mL) using the graduated cylinder.
 - Using the syringe pipette, very slowly (drop by drop) add the INVIZ™ solution to the vigorously agitated cold water (to prevent clumping). Depending on the volume of the syringe pipette, it will likely need to be filled multiple times to add the desired volume of INVIZ™ solution to the dispersion. When all of the aliquot of INVIZ™ solution has been added, allow dispersion to continue stirring.
 - Allow the dispersion to stir overnight (under a hood if possible) to allow the alcohol to evaporate.
- 4) Step four (optional)
- If a plasticizer is desired, determine an appropriate plasticizer. (A list of INVIZ™ plasticizers is available upon request.)
 - Determine the percent solids of the dispersion using a moisture balance or standard oven method.
 - Calculate desired percentage of plasticizer to add. (Ex. 30% (w/w) of the crude protein of an aliquot of the dispersion. If a 100 g aliquot of the dispersion is 7% solids which is entirely INVIZ™ and INVIZ™ is 89% crude protein (%db), 30% of the mass of the crude protein in the aliquot would give the amount of plasticizer to add. Example values are given below.)

Mass of Dispersion Aliquot (g):	Percent Solids of Dispersion (%):	Mass INVIZ™ in Aliquot (g):	Crude Protein of Dispersed INVIZ™ (% db):	Mass Crude Protein in Aliquot (g):	Percent of Propylene Glycol to be Dissolved (%/Mass Crude Protein):	Mass Propylene Glycol to be Dissolved (g):	Density of Propylene Glycol (g/mL):	Volume Propylene Glycol to be Dissolved (mL):
100.0	7.00%	7.00	89	6.23	30%	1.87	1.036	1.804

- Weigh out the desired aliquot of the dispersion.
 - Add the volume of plasticizer calculated (if desired) to the agitated dispersion using the macropipette and allow to continue stirring.
- 5) Step five
- The dispersion is ready for application. There are a number of ways to apply the solution to the object to be treated including spray coating and submersion. If the dispersion settles out after agitation has ceased, simply re-agitate. The shelf life of the dispersion is limited.