Demixing of Acetone-Salt Water

**Equipment:**
glass cylinder or high form glass beaker (400 mL)
2 graduated cylinders
magnetic stirrer and stir bar
mortar with pestle
glass beaker (50 mL)

**Chemicals:**
sodium chloride
acetone
deionized water
methyl violet

**Safety:**
acetone (CH₃COCH₃):

\[\text{H225, H319, H336, EUH066} \]
\[\text{P210, P233, P305 + P351 + P338} \]
methyl violet:

\[\text{H302-318-351-410} \]
\[\text{P280-281-305 + 351 + 338-308 + 313} \]

Both liquid acetone and acetone vapor are highly flammable. Acetone has a relatively high vapor pressure and should be handled only with adequate ventilation or in a fume hood. Methyl violet can cause serious eye damage. Affected eyes should be rinsed cautiously with water for several minutes. It is necessary to wear safety glasses and protective gloves.

**Procedure:**

**Preparation:** About 30 g of sodium chloride are finely ground using a mortar and pestle; 20 g of the salt are placed into the small beaker. 100 mL of acetone colored pale purple with about 0.5 mm³ of methyl violet powder are filled into the glass cylinder.

**Procedure:** 100 mL of water are added to the acetone in the glass cylinder and the liquid is thoroughly stirred with the magnetic stirrer. A homogeneous solution is obtained. Subsequently, the content of the small beaker is added und the liquid is stirred continuously until all the sodium chloride has dissolved.

**Observation:**
The result is a deep purple acetone layer of about 50 mL on top of a pale purple water layer.
Tip: One should not add too much dye, because it is not possible to see the difference between the two layers if the color is too intensive. One has also to consider that the pale purple color of the acetone deepens with the addition of water.

**Explanation:**

Acetone and pure water are soluble in all proportions; they are completely miscible. The reason for this behavior is the formation of hydrogen bonding interactions between the oxygen atom of acetone molecules and the O-H bond of water molecules.

However, when salt is added to the mixture, the resulting Na\(^+\) and Cl\(^-\) ions interact very strongly with the water molecules through ion-dipole forces. These ion-dipole interactions are much stronger than the acetone-water hydrogen bonds. As a result, the acetone molecules are forced out of the aqueous phase and two layers are formed: a less dense acetone layer on top and a salt water layer at the bottom. Obviously, acetone and salt water are incompatible and therefore immiscible; they do not mix in all proportions.

The dye methyl violet, which dissolves better in acetone than in water, accumulates in the acetone layer.

This “salting out” technique can be used to remove organic molecules from an aqueous solution.

**Disposal:**

The acetone-salt water mixture has to be disposed of as hazardous waste in accordance with the guidelines of the particular institution.