Increase in Surface Tension due to Insoluble Impurities:

If the impurity has stronger cohesive forces with the liquid molecules than the molecules have with each other, it can lead to an increase in surface tension. The impurity molecules may help enhance the overall cohesive forces at the liquid surface.

→ *Examples:*

- **Palmitic acid or stearic acid (long-chain fatty acids):**
  Fatty acis are amphiphilic molecules with hydrophobic and hydrophilic regions. In water, these molecules can align themselves at the surface, effectively increasing the cohesive forces at the interface and causing an increase in surface tension.
- **Long-chain Organic Molecules in Water:**
  Some long-chain organic molecules, especially those with polar functional groups, can increase the surface tension in liquids. Alcohols like Octadecanol (1-octadecanol) have hydrophobic tails and hydrophilic heads. When added to water, they arrange themselves at the surface, reinforcing the cohesive forces and leading to an increase in surface tension.
- **Mud, Sand in Water:**
  Mud particles depending on the granular size, can alter the surface tension of water. Sand(insoluble impurity) when added to water neither increases nor decreases the srface tension, as surface tension is surface phenomena, where as particles like sand do not affect the surface of the solvent but rather stay in the bulk of the solvent.
- **Organic Polymers in Water:**
  Polymers like PTFE(Polytetrafluoroethylene) can reduce the ability of water molecules to form cohesive bonds at the surface, leading to an increase in surface tension.
  Certain high molecular weight organic polymers, may exhibit an increase in surface tension when added to water.
- **Polysaccharides in Water:**
  Some polysaccharides have hydrophobic portions that can contribute to an increase in surface tension when added to water.
- **Proteins in Aqueous Solutions:**
  Proteins when added to aqueous solutions can alter the surface tension. The hydrophobic regions may align at the surface, increasing cohesive forces, increasing surface tension.
- **Silica particles in Water:**
  Silica nanoparticles can adsorb at the liquid surface, limiting the liquid's ability to spread. This can result in an increase in surface tension. Not only silica(SiO_2), few other metal oxide nanoparticles can also show this effect.
- **Salts of Certain Heavy Metals:**
  Some salts of heavy metals, like lead acetate($Pb(CH_3COO)_2$), have been reported to increase the surface tension of water.
- **Certain Inorganic Compounds:**
  Some inorganic compounds, particularly those with complex structures or large cations, may increase surface tension. For example, thorium nitrate($Th(NO_3)_4$) has been reported to increase the surface tension of water.
- **Ferric Chloride($FeCl_3$):**
  Ferric Chloride in certain concentration has been observed to increase the surface tension of water.

No effect on Surface Tension due to Insoluble Impurities:

In some cases, the insoluble impurity might not interact strongly with the liquid molecules and there may be no significant change in surface tension.The impurity particles may simply remain dispersed in the liquid without affecting the cohesive forces at the surface.

→ Examples:

- **Barium Sulfate($BaSO_4$):**
  $BaSO_4$ is insoluble in water, and it forms a precipitate. $BaSO_4$ particles do not interact with the water molecules significantly. Therefore the addition of Barium Sulfate is unlikely to have a measurable impact on the surface tension of water.
- **Silver Chloride(AgCl):**
  AgCl does not dissolve in water readily. Instead it forms a white precipitate. Since the particles of AgCl do not become hydrated and do not interact extensively with water molecules at the surface, they generally do not alter the surface tension of water to a significant extent.
- **Certain Salts:**
  Salts with hydration energy lower than their lattice energy, do not dissolve in solvents. Usually they form precipitates which do not affect the surface tension of the liquid. PbS, Hg_2Cl_2, AgBr are some of the examples.

CONCLUSION:

Therefore effect of insoluble impurities on the surface tension of liquids is dependent on the properties of the liquid and the impurity.

Specific details about the system in the statement would be necessary to predict the impact on surface tension.

As no details are specified in the give question, the surface tension may increase, decrease or stay the same depending on the impurity ans liquid.

So the give answer, “Statement I is incorrect but Statement II is correct”, is not correct in many cases

Proposed Answer: Option ID: 5335431476

i.e., “Both Statement I and Statement II are incorrect”

NOTE:

Kindly consider that I am not able to provide reputable sources for the above information as the effect on surface tension due to impurities(soluble, insoluble and

partially soluble) is not discussed in the reduced syllabus of NTA for classes 11^{th} and 12^{th} and is not discussed in the previous grades extensively.