

What Is The Name For A Solute That Does Not Exert A Vapor Pressure When It Is Dissolved In A Liquid?A.

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Understanding the behavior of solutes in solvents is fundamental to the study of solutions in chemistry. When a solute is dissolved in a liquid, it often influences the physical properties of the resulting solution, notably its vapor pressure. However, certain solutes, when dissolved, do not exert any vapor pressure at all. This intriguing phenomenon raises questions about the nature and classification of such solutes. In this article, we will explore the terminology, underlying principles, and implications of solutes that do not exert vapor pressure when dissolved in a liquid, with particular emphasis on the term "nonelectrolyte" and its relevance in this context.

Understanding Vapor Pressure and Its Relation to Solutes

What Is Vapor Pressure?

Vapor pressure is defined as the pressure exerted by a vapor in thermodynamic equilibrium with its condensed phases (solid or liquid) at a given temperature in a closed system. It is a measure of a liquid's volatility; the higher the vapor pressure, the more readily the liquid evaporates.

How Do Solutes Affect Vapor Pressure?

When a non-volatile solute dissolves in a solvent, the vapor pressure of the solvent decreases. This phenomenon is described by Raoult's Law, which states that the vapor pressure of the solvent in a solution is proportional to its mole fraction:

$$P_{\text{solution}} = X_{\text{solvent}} \times P_{\text{pure solvent}}$$

where:

- P_{solution} is the vapor pressure of the solvent in the solution,
- X_{solvent} is the mole fraction of the solvent,
- $P_{\text{pure solvent}}$ is the vapor pressure of the pure solvent.

The addition of a solute reduces the mole fraction of the solvent, thus lowering the vapor pressure. This effect is significant in processes such as boiling point elevation and freezing point depression.

What Are Solutes That Do Not Exert Vapor Pressure?

Definition and Characteristics

A solute that does not exert vapor pressure when dissolved in a liquid is essentially a substance that remains non-volatile within the solution. This means it does not produce any measurable vapor phase at the temperature in question, nor does it significantly contribute to the equilibrium vapor pressure above the solution.

Common Examples

- Non-volatile inorganic salts (e.g., sodium chloride, potassium nitrate): When dissolved in water, these salts dissociate into ions but do not volatilize.
- Sugars and other large organic molecules (e.g., glucose, sucrose): These compounds are highly non-volatile and do not produce vapor under typical conditions.
- Polymer solutions (e.g., polyethylene dissolved in certain solvents): Polymers often have negligible vapor pressure.

Terminology and Classification of Such Solutes

Non-Volatile Solutes

The most straightforward term for these substances is non-volatile solutes. They do not have appreciable vapor pressure themselves, and their presence in a solution primarily affects colligative properties rather than the vapor phase.

Implications for Colligative Properties

Since non-volatile solutes do not exert vapor pressure, their main influence is on colligative properties, which depend solely on the number of solute particles in solution:

- Vapor pressure lowering: The presence of non-volatile solutes reduces vapor pressure.
- Boiling point elevation: Increased due to decreased vapor pressure.
- Freezing point depression: Due to the presence of solutes disrupting the formation of crystalline structures.
- osmotic pressure: Significant in biological and chemical processes.

Are Such Solutes Considered Electrolytes?

While many non-volatile solutes are electrolytes (substances that dissociate into ions in solution), the key point is that their vapor pressure contribution is negligible. The term "electrolyte" emphasizes conductance and dissociation rather than vapor pressure behavior.

Electrolytes can be classified as:

- Strong electrolytes: Dissociate completely (e.g., NaCl).
- Weak electrolytes: Dissociate partially (e.g., acetic acid).

Despite their ionic nature, they do not exert vapor pressure directly; instead, their influence on vapor pressure reduction is through the colligative effect of dissolved particles.

Special Cases: Solutes That Do Not Exert Any Vapor Pressure

Pure Solids and Liquids in Solution

In certain situations, the solute might be a solid or liquid that remains in a condensed phase and does not vaporize under the conditions considered. For example:

- Insoluble solids: Such as sand in water, which does not dissolve or exert vapor pressure.
- Immiscible liquids: Such as oil in water, which do not mix or influence vapor pressure of each other directly unless forming an emulsion.

Gases as Solutes

Gases typically exert vapor pressure themselves, but if a gas is dissolved in a liquid and remains non-volatile at the temperature considered, it effectively does not exert vapor pressure. For example:

- Inert gases like helium or argon dissolved in liquids may have negligible vapor pressure contribution if conditions prevent their evaporation.

Conclusion: The Term for Such Solutes

The key term that describes a solute which, when dissolved, does not exert any vapor pressure is non-volatile solute. These substances do not produce vapor under the conditions of interest and mainly influence the physical properties of solutions through colligative effects rather than vapor pressure contribution.

While the question's options might vary, the most precise and widely accepted terminology for a

solute that does not exert vapor pressure is non-volatile solute. This classification helps chemists understand and predict how such solutes influence phenomena like boiling point elevation, freezing point depression, and osmotic pressure without directly contributing to the vapor phase.

In summary:

- The term for a solute that does not exert vapor pressure when dissolved is non-volatile solute.
- These substances significantly influence solution properties through colligative effects.
- Understanding their behavior is crucial in fields such as solution chemistry, pharmacology, and industrial processes.

By grasping this concept, scientists and engineers can better manipulate solution conditions for desired outcomes, whether in chemical manufacturing, biological systems, or environmental applications.

Frequently Asked Questions

What term describes a solute that, when dissolved, does not exert vapor pressure on the solvent?

The solute is called a non-volatile solute.

Why does a non-volatile solute not exert vapor pressure in a solution?

Because it does not have a significant vapor pressure itself and does not escape into the gas phase under normal conditions.

What is the effect of a non-volatile solute on the vapor pressure of a solvent?

It lowers the vapor pressure of the solvent, following Raoult's law, but does not contribute its own vapor pressure.

In terms of vapor pressure, how is a non-volatile solute different from a volatile solute?

A non-volatile solute does not exert vapor pressure, whereas a volatile solute does contribute vapor pressure to the solution.

What is an example of a non-volatile solute commonly used in solutions?

Table salt (sodium chloride) is a common non-volatile solute.

How does the presence of a non-volatile solute affect the boiling point of a solution?

It increases the boiling point of the solution, a phenomenon known as boiling point elevation.

Additional Resources

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In the world of chemistry, the behavior of solutions—particularly how solutes influence the physical properties of solvents—has long fascinated scientists. Among these properties, vapor pressure plays a central role in understanding phenomena such as boiling, evaporation, and distillation. But what if a solute, when dissolved in a liquid, exerts no vapor pressure at all? What term is used to describe such a substance? This question leads us into the fascinating realm of ideal and non-volatile solutes, ultimately revealing the concept of an inert or non-volatile solute—an important cornerstone in solution chemistry.

Understanding Vapor Pressure and Its Significance

Before diving into the specific terminology, it's crucial to comprehend what vapor pressure entails and why it matters.

What Is Vapor Pressure?

Vapor pressure refers to the pressure exerted by the vapor of a liquid when it is in equilibrium with its liquid phase at a given temperature. It is a measure of a liquid's tendency to evaporate. The higher the vapor pressure, the more readily the liquid molecules escape into the vapor phase.

For example, water at room temperature has a certain vapor pressure, which increases with temperature. When the vapor pressure equals atmospheric pressure, the liquid boils.

How Do Solutes Affect Vapor Pressure?

When a non-volatile solute dissolves in a solvent, it tends to lower the solvent's vapor pressure—a phenomenon known as vapor pressure lowering. This effect is explained by Raoult's Law, which states:

> The vapor pressure of a solvent in a solution is proportional to the mole fraction of the solvent.

Mathematically:

$$P_A = X_A P_A^0$$

where:

- P_A is the vapor pressure of the solvent in the solution,
- X_A is the mole fraction of the solvent,

- (P_A^0) is the vapor pressure of the pure solvent.

Since adding a solute reduces the mole fraction of the solvent ((X_A)), the vapor pressure decreases.

The Special Case: Solutes That Do Not Exert Vapor Pressure

Now, let's consider the scenario where the solute does not exert any vapor pressure upon dissolving—meaning it remains in the liquid phase without entering the vapor phase at all. Such solutes are often described as non-volatile.

Defining Non-Volatile Solutes

A non-volatile solute is a substance that, when dissolved in a liquid, does not produce any measurable vapor pressure at the temperature in question. In other words:

- It does not evaporate or transition into the vapor phase under the given conditions.
- Its presence influences the physical properties of the solution (such as vapor pressure, boiling point, and freezing point) primarily through dilution effects rather than vapor phase activity.

Common examples include:

- Sodium chloride (NaCl) in water
- Sugar (sucrose) in tea
- Epsom salts (magnesium sulfate) in solution

In all these cases, the solutes are considered non-volatile because their vapor pressure is negligible or effectively zero at standard conditions.

Terminology: What Do Chemists Call Such Solutes?

Understanding the terminology used in chemistry to describe these substances is fundamental.

Non-Volatile Solutes

The most straightforward term is non-volatile solute. This designation emphasizes the solute's lack of vapor pressure and its inability to vaporize under normal conditions.

Inert Solutes

Sometimes, the term inert is used—though it can be context-dependent. An inert solute typically refers to a substance that does not react chemically with the solvent or other components, and often also has negligible vapor pressure. However, “inert” does not necessarily specify vapor pressure behavior universally.

Non-Volatile vs. Volatile Solutes

- Volatile solutes: Substances that readily vaporize and exert significant vapor pressure when dissolved.
- Non-volatile solutes: Substances that do not vaporize; they exert no vapor pressure.

In solution chemistry, the distinction between these types of solutes is vital because their effects on the physical properties of the solution differ markedly.

The Role of Non-Volatile Solutes in Solution Properties

Non-volatile solutes influence solutions predominantly through colligative properties—properties that depend on the number of solute particles rather than their identity.

Colligative Properties Affected

1. Vapor Pressure Lowering: As previously discussed, non-volatile solutes reduce the vapor pressure of the solvent, leading to higher boiling points.
2. Boiling Point Elevation: The presence of a non-volatile solute raises the boiling point of the solvent.
3. Freezing Point Depression: Such solutes lower the freezing point.
4. Osmotic Pressure: They generate osmotic pressure across semi-permeable membranes.

These effects are exploited in numerous applications, from food preservation to medical treatments.

Practical Applications and Implications

Understanding non-volatile solutes and their effects on vapor pressure has significant practical implications across various fields.

Industrial Processes

- Distillation: Non-volatile solutes are used to modify boiling points without vaporizing themselves, aiding in separation processes.
- Pharmaceuticals: Formulating solutions with non-volatile solutes can control osmotic pressure or stability.

Food Industry

- Salt and Sugar in Food Preservation: Non-volatile salts and sugars prevent microbial growth by altering osmotic conditions and boiling/freezing points.

Scientific Research

- Colligative Property Experiments: Non-volatile solutes are ideal for studying colligative effects because their vapor pressures are negligible, simplifying theoretical models.

Summary: The Technical Term for the Solute

To directly answer the initial question:

The name for a solute that does not exert a vapor pressure when dissolved in a liquid is a non-volatile solute.

This terminology underscores the solute's lack of vaporization tendency at the relevant temperature and pressure conditions. By virtue of their non-volatile nature, these solutes influence the physical properties of solutions mainly through dilution and colligative effects, rather than direct vapor phase activity.

Final Thoughts

Understanding the behavior of non-volatile solutes is fundamental to both theoretical and applied chemistry. Their unique characteristic of exerting no vapor pressure shapes how solutions are formulated and manipulated across scientific and industrial domains. Recognizing this helps chemists design processes that leverage colligative properties—whether it's boiling point elevation in cooking, osmotic regulation in biological systems, or the distillation of complex mixtures.

In conclusion, non-volatile solutes are key players in the chemistry of solutions, providing a means to control and predict physical properties without contributing vapor pressure, thus enabling precise control in a vast array of scientific, industrial, and everyday applications.

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