COVALENT CHARACTER IN IONIC BONDS

When oppositely charged ions come into proximity, the interaction involves not only the attraction between the positively charged cation and the negatively charged anion but also concurrent repulsions between their respective nuclei. Consequently, there is a distortion or deformation of the anions, leading to the polarization of the electronic charge. This polarization causes the originally spherical electronic charge of the anion to become distorted.

As a consequence of ion polarization, an electric charge concentration emerges between the two nuclei, fostering the formation of a covalent bond characterized by a significant degree of charge separation. This process highlights the dynamic interplay of attractive and repulsive forces in the bonding of oppositely charged ions.

Fajan's Rule

The presence of covalent character in ionic compounds is a ubiquitous phenomenon, as there is no ionic compound that is entirely devoid of some degree of covalent character. The induction of covalent character, or the polarization of an ionic compound, occurs due to the distortion of an anion by a cation, a phenomenon known as the polarization of anion by a cation. The extent of polarization, or the distortion of the anion, directly correlates with the percentage of covalent character in the compound. Fajan's rule serves as a relative measure for covalent character and is guided by the following principles:

1. **Cation Size:** A smaller cation exhibits greater polarizing power due to its higher positive charge density and effective nuclear charge. The smaller cation exerts a stronger influence on the electrons of nearby anions, leading to the distortion of the anion's electron cloud and the introduction of covalent character.

2. **Anion Size:** Larger anions are more polarizable. In a larger anion, the nucleus has a weaker hold on outer electrons compared to smaller anions. Consequently, larger anions are more prone to distortion, resulting in a higher degree of covalent character in compounds with larger-sized anions.

3. **Magnitude of Charge:** The larger the magnitude of the charge on both cation and anion, the greater the polarizing power of the cation and the tendency of the anion to undergo polarization. Consequently, a larger charge magnitude is associated with a higher covalent character.

4. **Electron Configuration:** Cations with 18 electrons in the outermost shell, achieving a pseudo-noble gas electronic configuration, possess greater polarizing power compared to cations with 8 electrons in the outermost shell with a noble gas-type electronic configuration. This difference in electron configuration contributes to variations in the covalent character induced by these cations.

In summary, Fajan's rule provides a comprehensive framework for understanding the factors influencing covalent character in ionic compounds, encompassing cation size, anion size, charge magnitude, and electron configuration.