

# REASON BEHIND CHARGE SEPARATION IN CLOUD

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## Abstract

**Introduction:** Investigation the reason behind the charge separation in cloud. Why some clouds have positive charge at bottom and some clouds have negative charge at bottom?

**Keywords:** Temperature gradient, electron affinity, Bond length, electronegativity, bond energy.

**Explanation:** The intramolecular O-H bond length of water molecule is changed with temperature[1,2].

Bond energy of O-H bond of water molecule decreases with the increase of bond length[3]. Electron affinity of water molecule changes with bond length[4].

Electron affinity generally decreases from left to right across the periodic table and electronegativity increases from left to right[5].

So, we can conclude that if electron affinity decreases then electronegativity increases.

So, with the change of bond length or temperature, there is a change of some kind of electron attraction power of water molecule.

**Type 1 cloud :** If the height of cloud itself is very high then due to atmospheric temperature gradient [6] in troposphere, the bottom point of the cloud is hotter than the upper part of the cloud.

Now, cloud is formed by water vapour i.e water molecules. so, these water molecules are at different temperature. Due to these difference in temperature, the water molecules at bottom are hotter than water molecules at top of the cloud. For these reason they have different attraction power for electron. This change in electron attraction power of water molecules due to temperature variation separate the charge in the cloud.

If we assume that with the increase of temperature some kind of electronegativity of water molecule decrease, then the bottom point of the cloud will be positively charged and top will be negatively charged.

**Type 2 cloud :** If the height of the of the cloud itself is not very high but contain ice and hailstones, in this type of cloud atmospheric temperature is not important. Here condensation due to cooling play an important role. In this type of cloud bottom part full fill with ice and upper part contain water vapour.

So, upper part of this type of cloud hotter than bottom point.

So, bond length of water molecules in upper part is greater than lower part. So, in this case lower part of the cloud is negatively charged and upper part is positively charged like thunderstorm[7].

**Conclusions:** Variation of temperature vary the O-H bond length of water molecule. This variation of bond length vary the attraction power for electron (some kind of electronegativity) of water molecule in cloud. This variation of attraction power for electron of water molecule with temperature cause the separation of charge in cloud.

## References:

- [1] Becka, L.N and Cruickshank, D.W.J Journal—Acta Crystallographica, year-1961, volume 14, number 10, pages 1092
- [2] [https://www.researchgate.net/figure/H-O-bond-length-vs-temperature\\_fig6\\_249517727](https://www.researchgate.net/figure/H-O-bond-length-vs-temperature_fig6_249517727)
- [3] [https://chem.libretexts.org/Textbook\\_Maps/Physical\\_and\\_Theoretical\\_Chemistry\\_Textbook\\_Maps/Supplemental\\_Modules\\_\(Physical\\_and\\_Theoretical\\_Chemistry\)/Chemical\\_Bonding/Fundamentals\\_of\\_Chemical\\_Bonding/Chemical\\_Bonds/Bond\\_Lengths\\_and\\_Energies](https://chem.libretexts.org/Textbook_Maps/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Chemical_Bonding/Fundamentals_of_Chemical_Bonding/Chemical_Bonds/Bond_Lengths_and_Energies)
- [4] Nature communications 9, Article number :247(2018)
- [5] D.F shriver, p.w. Atkins shiver and Atkins, inorganic chemistry, 3<sup>rd</sup> edition, 1999, oxford university press, oxford.
- [6] <https://www.ck12.org/earth-science/troposphere/lesson/troposphere-HS-ES/>
- [7] <https://www.windows2universe.org/earth/Atmosphere/tstorm.html>