

Hello students, I Ms. Anuja Naik, Assistant Professor in Chemistry from Ganpat Parsekar College of Education, Harnal Pernem Goa.

I will be dealing with the role of deactivating groups in Electrophilic Aromatic Substitution reactions.

Today, I will be dealing with in detail:

What are deactivating groups?

Different deactivating groups,

Effect of substituents on orientation, and

Various electrophilic aromatic substitution reactions we will see.

So at the end of my session, students will be able to

Define deactivating groups,

Identify the various deactivating groups,

Explain the directive effects of deactivating groups, and

Predict the product of the reaction.

Now what are deactivating groups?

Deactivating groups are the groups which deactivate a benzene ring towards electrophilic attack. They are also called electron withdrawing groups or meta directors. Deactivating groups destabilize the carbocation intermediates and increase the energy of the transition state and therefore decrease the rate of reaction and thereby making electrophilic aromatic substitution reaction slower.

There are different deactivating groups. They are categorized as strongly deactivating groups, moderately deactivating groups, and weakly deactivating groups.

Now let us take one example of electron withdrawing group here. In this case oxygen is more

electronegative than carbon. Therefore, oxygen will withdraw the electrons from carbon, thereby making carbon electrophilic and carbon which is electrophilic in nature, will withdraw the electrons from the benzene ring.

Now let us consider here G as the electron withdrawing group. Electron withdrawing group withdraws the electrons from the benzene ring and deactivates the ring. So, once the electron withdrawing group withdraws the electrons from the benzene ring, it destabilizes carbocation and deactivates the ring.

The same is true when we take Cl as a substituent.

Now, here are the different resonating structures that we get for Nitrobenzene once we consider resonance effect.

Next, look at the directive effects of Nitro group.

Here you will get different resonating structures once you show ortho attack, meta attack and para attack.

Once you show ortho attack you will get unstable structure and the same is true once you show para attack. Now if you count the number of the resonating structures obtained after meta attack, they are more than ortho attack and para attack. This clearly indicates that electron withdrawing groups are meta directors.

Next, the effect of halogen. Here you will be getting again different resonating structures once you show ortho attack, meta attack and para attack. Now in case of ortho and para attack, you are getting one unstable structure, but if you consider resonance effect, chlorine will donate the electrons to electron deficient carbon thereby giving halonium ion where Chlorine bears positive charge, which is comparatively stable and therefore you can conclude that chlorine is categorized under weakly deactivating group.

Now we will look at some electrophilic aromatic substitution reactions,

First one, nitration of benzaldehyde. Now in benzaldehyde -CHO group is electron withdrawing group. So once you carry out nitration reaction you will end up in getting meta Nitrobenzaldehyde.

The same is true in case of nitrobenzene. Once you carry out nitration reaction on Nitrobenzene, you will end up in getting meta dinitrobenzene. Nitro group is electron withdrawing group, and meta director.

Next, sulfonation of benzene sulfonic acid. Here Benzene sulphonic acid on sulfonation gives meta Benzene disulfonic acid.

Next, Chlorination of Benzoyl chloride, benzoyl chloride on chlorination reaction will give meta chloro. benzoyl chloride.

And these are the references.

Thank you.