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Date: May 13, 1966

From: J. W. Summers

Summary of McGill Polymer Discussions -

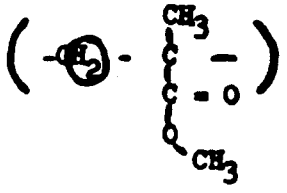
THE STABILITY OF POLYVINYL CHLORIDE

McGill University
Montreal, Quebec
May 3, 1966

"The Study of Polyvinyl Chlorids by High Resolution NMR Spectroscopy". Dr. Frank Bovey, Bell Telephone Laboratories, Murray Hill, New Jersey.

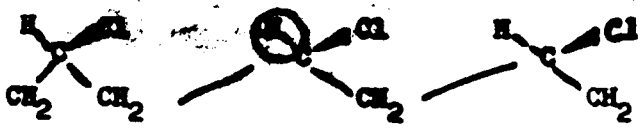
Dr. Bovey gave a very interesting talk on the stereo chemical structure of PVC as determined by NMR.

His initial work on stereo chemistry of polymers was done with poly methyl methacrylate because it gives a much simpler spectrum than PVC. Polymethyl methacrylate has only one kind of hydrogen on the chain backbone to account for

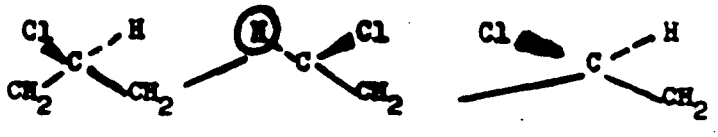


PVC has two.

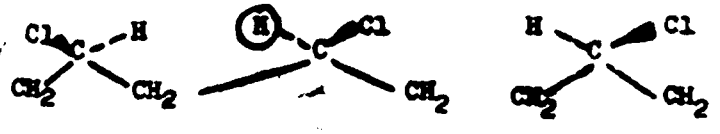
The PVC spectrum was analyzed and structure assigned by using model compounds and PVC made from deuterated vinyl chloride. The results showed hydrogen on the same carbon as chlorine (circled), has three chemical environments depending on whether hydrogen two carbons down the chain is on the same or opposite side of the chain.



ISOTACTIC ENVIRONMENT



SYNDIOTACTIC ENVIRONMENT



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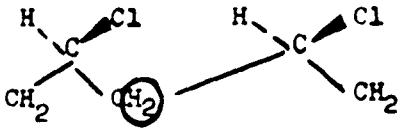
The methylene hydrogen (circled) shows two chemical environments.



ISOTACTIC ENVIRONMENT

SYNDIOTACTIC ENVIRONMENT

His conclusions were:

1. Stereo structure of PVC changes little with polymerization temperature. However, syndiotactic structure is favored by lower polymerization temperatures.

Polymerization Temperature	Stereo Structure*
100°C.	σ = 0.52
50°C.	σ = 0.51
0°C.	σ = 0.47
-78°C.	σ = 0.42

* σ = Probability that the next monomer unit will add the same stereo structure (Isotactic) as the last unit on the chain.

2. Infra-red shows more syndiotactic structure than NMR. The reason for the difference has not been resolved.

3. He sees no evidence for head to head units (<1%).

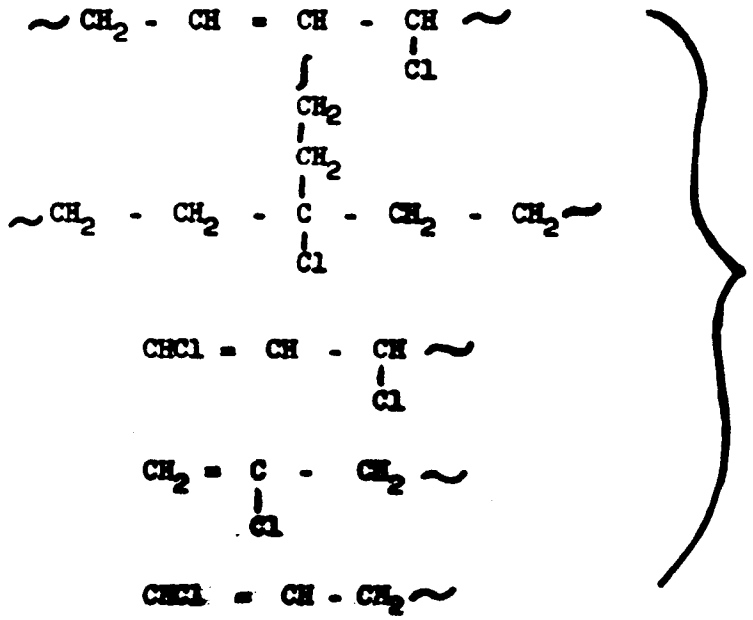
"Thermal Decomposition of Polyvinyl Chloride". Dr. Alain Guyot, Institut de Recherches sur la Catalyse, Villeurbanne, France.

Although Dr. Guyot's talk was interesting, it was hard to follow because of his poor English and poor slides. He talked on three types of thermal degradation.

1. HCl evolution.
2. Color formation.
3. Crosslinking.

Dr. Guyot discussed the role of oxygen in the degradation. He believes oxygen reacts with the double bonds in degraded PVC in an exothermic reaction which raises the local temperature in the PVC. This can account for an increased rate of HCl evolution because of the increased temperature and for less color formation because oxygen is eliminating conjugated double bonds. In polymer solutions oxygen does not increase the rate of HCl evolution because the heat of reaction is taken up by the solvent and there is no increase in local temperature. Other evidence is that degraded PVC increases in weight when exposed to oxygen apparently from oxygen addition.

Studies of decomposition of model compounds such as --



The poor quality of the slide made it difficult to see all the structures tested.

shows that the allylic chloride which would be formed by a double bond in the middle of a polymer chain is the least stable of structures studied. Chain transfer reactions which may form a double bond on the chain end are not as unstable as the allylic chloride in the middle of a chain.

"Unusual Behavior of Vinyl Stabilizers". Mr. Arthur Hecker, Argus Chemical Co., Brooklyn, N. Y.

Mr. Hecker listed a considerable amount of odd or unexpected behavior in stabilizer-PVC interactions but technical reasoning behind the unusual behavior was completely lacking. I will also pass on the information without interpretation.

1. PVC with lead silicate stabilizer forms much color but little PVC degradation as measured by chloride formation. But PVC with lead silicate and Cadmium stearate forms little color and has much chloride formation.

2. The same is true of Barium-Cadmium systems. Barium Laurate stabilized PVC forms severe color but little chloride. Barium Laurate, Cadmium Laurate mixture forms little color but much chloride.

3. Gaseous HCl at room temperature discolors stabilized PVC compounds.

4. Static oven heat stability is better for high molecular weight PVC.

   Mill stability and brabender stability is better for low molecular weight resins.

"Processing of Polyvinyl Chloride". Mr. W. Allan Rabb, Shawinigan Chemicals, Montreal.

Mr. Rabb described the processes for PVC for people who are not knowledgeable in this area. Most of the processes are well known to everyone in BFG so I will not describe them in detail.

1. Brabender mixing.
2. Henschel mixing.
3. Milling.
4. Calendering.
5. Sheet extrusion.
6. Shape extrusion.
7. Electrostatic coating.
8. Flexible extrusion.
9. Fluidized bed coating.

"Simple Monitor Devices for Weather Exposure of Plastics". Dr. William Brucksch, National Bureau of Standards.

Dr. Brucksch is making devices to accurately measure the weather. His monitor devices measure:

1. Radiation of sun-langleys.
2. Temperature on a black-body and white-body.
3. Rain and dew - by measuring the time the surface is wet.

4. Contaminants - atmosphere.
5. Stress - amperiodic.

Dr. Brucksch hopes to be able to correlate weathering between various cities and indoor exposure. His indoor weathering device will be a tank of water with immersed samples so he can control temperature, contamination, and light radiation.

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