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Gas phase reactions of isoprene for modeling rubber degradation products: 43rd ASMS Meeting on Mass Spectrometry and Allied Topics, Atlanta, June 1995

Publication: 1995 - 045

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Modeling Scrap Tire Pyrolysis

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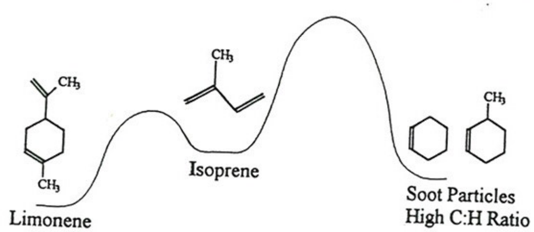
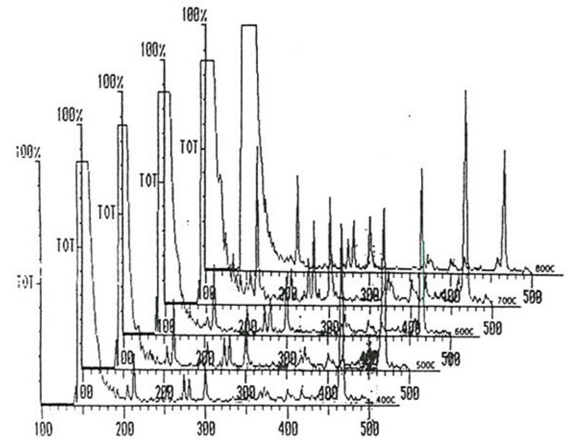
Estimates of the generation of scrap tires in the United States are on the order of 2 million tons per year. Although these tires contain a high percentage of useful hydrocarbons of these 2 million tons only 30 percent are converted to other uses. The remaining 70 percent are simply disposed of in land fills, accumulated in large quantities at questionable concentration sites or they are illegally disposed of in such places as roadside ditches or river and stream beds. This 1.4 million tons of scrap tires better represent a resource for valuable and recyclable materials. The bead and belt steel has value and should be recycled. The rubber itself can be processed pyrolyticly and yield light hydrocarbon products such as limonene. The resulting solid char can be the starting material from which activated carbon is produced. Recently, pyrolytic recycling of scrap tires (thermal decomposition in the absence of oxygen) is receiving renewed interest because of its ability to produce valuable products which can dramatically offset the costs of the pyrolytic process. Our process is an improvement over current processes and procedures. Since pyrolysis is decomposition in the absence of a combustible atmosphere many processes evacuate their systems and use complex machinery to maintain this sealed system. We prefer to displace the combustible atmosphere with steam. At the same time we eliminate the need for evacuation we also eliminate the need for complex hard seals to seal and isolate the system. Since we operate at ambient air pressure we are able to use simple water traps to isolate our system from the atmosphere. This separation allows us to control emission releases in to the environment. This water trap sealing system also allows for material to easily and continuously be fed in to our system and for the solid products





to just as easily exit our system. Vapors generated are quickly and easily condensed along with the steam preventing a build up of pressure. The small amount of gases generated ar contained and easily removed from a collection tower also attached to the system. This process increases the affiance and control over present approaches and lowering the energy requirements while maximizing the collection and generation of valuable products. What we are presenting are some of the results of bench set ups which are also briefly described.

One of the more interesting results from our work is the proposed idea of that the residence time that the generated vapors spend in the heat of the reaction chamber influence the type of liquid products formed. As can be seen in the attached figure we propose that secondary reactions occur relative to the amount of energy the isoprene and products gain while in the reaction chamber. If the vapors do not escape the reaction chamber quickly they will obtain enough energy to form less desirable hydrocarbons having a high C:H ratio rather the more valuable saturated hydrocarbons, such as limonene. The chromatogram below shows the limonene peak at 468 is stable for the 4 temperatures prior to 800 degrees. But the limonene peak drops significantly at 800 degrees which corresponds to a change in the products formed due to increased gas phase reactions occuring in the pyrolysis reactor.