IMPROVEMENT OF THE PRODUCTION OF AROMATIC COMPOUNDS OBTAINED FROM THE PYROLYSIS OF SCRAP TIRE RUBBER USING HETEROPOLYACIDS-BASED CATALYSTS

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Mixture of aromatics, paraffin, olefin and sulfur and nitrogen compounds in lower concentrations \[2\]

Chemical synthesis of plastics, synthetic rubber, paints, pigments, explosives, pesticides, fragrances, degreasers and cleaning products. \[4\]

Introducción

AROMATIC

Zeolites
Bifunctional
Pure Silica

- Lower Si/Al ratio increase in the concentration of single ring aromatic compounds
- Decrease of oil yield and an increase of gas yield
- High cracking activity
NEW ALTERNATIVE

- Acid and redox functions
- Lewis and Brønsted acidity

Different reactions:
- Oxidation.
- Reduction.
- Condensation.
- Carboxylation.
- Dehydrogenation.
- Isomerization
Pyrolysis of scrap tire rubber for the production of simple ring aromatics

Optimization of scrap tire rubber pyrolysis without catalyst 20 wt% on commercial silica CARiACT Q-10

Pyrolysis of scrap tire rubber with a catalytic stage

H₄PMo₁₁VO₄₀
(HPMoV)

H₃PMo₁₂O₄₀
(HPMo)

H₃PW₁₂O₄₀
(HPW)

Methodology

$D_p = 0.85 - 1\text{mm}$

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration (wt%)*</th>
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</thead>
<tbody>
<tr>
<td>NR</td>
<td>50.05 ± 2.07</td>
</tr>
<tr>
<td>SBR</td>
<td>1.44 ± 0.125</td>
</tr>
<tr>
<td>BR*</td>
<td>14.72 ± 2.195</td>
</tr>
<tr>
<td>Black carbon + additives</td>
<td>33.79</td>
</tr>
</tbody>
</table>

Note: *It was determined by difference. **Dry basis.
Methodology

Optimization of scrap tire rubber pyrolysis without catalyst

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Nitrogen volumetric flow (ml/min at TPN)</th>
</tr>
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<tbody>
<tr>
<td>400</td>
<td>116</td>
</tr>
<tr>
<td>466</td>
<td>155</td>
</tr>
<tr>
<td>533</td>
<td>223</td>
</tr>
<tr>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

Response variable 1

Pyrolytic oil yield (wt %)

Response variable 2

Aromatic compounds yield (wt%)
Methodology

Pyrolysis of scrap tire rubber with catalytic stage

- **Catalyst/tire ratio**: 0.2
- **Operating conditions of catalytic bed**: 350 °C and 155 Nml/min at TPN
- **Operating conditions of scrap tire bed**: Most favorable operating conditions found in stage 1
Results and discussion

MAXIMUM OIL YIELD
Results and discussion

600 °C and 233 Nml/min

466 °C and 155 Nml/min
Results and discussion

Brønsted Acidity = Increase gas yield

Cracking reactions

The oil production decreases with the catalysts
Results and discussion

Concentration of the aromatics and the partially saturated cyclic compounds in the pyrolytic oil
Conclusions

- The operating variables for the pyrolysis of scrap tires having the most influence on distribution of products are the.
  **The highest yield of pyrolysis oil does not necessarily lead to a higher yield of aromatics.**

- The HPA based catalysts used in the catalytic reforming of volatiles from STR pyrolysis allow increasing the production of aromatic compounds but decrease the pyrolytic oil yield.

- The number of Brønsted sites do not promote the oil yield, founding in this study a decrease up to 41% when the Tungsten-based catalyst was used. Therefore, the gas yield was slightly increased.
Conclusions

✓ On the contrary, the aromatic concentration in pyrolytic oil was increased to close to 140% when Molybdenum-based catalysts were used. Conversely, at these conditions, the concentration of partially saturated cyclic compounds, such as limonene, was drastically decreased.

✓ Cymenes compounds were the major aromatic compounds in pyrolytic oil as a result of the reforming of D, L limonene. The results show that the Molybdenum-based catalysts with an high ratio of Lewis/Brønsted acid sites favors its production.
THANK YOU FOR YOUR ATTENTION

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