Separating Plastics by Density

Introduction:
When plastics are recycled it is particularly important that they are separated by type. The numbers on recyclable plastics help this process along, but on a large scale it is inefficient to hand sort the items. Instead materials are separated by density. We will mimic this process using liquids and mixtures of various densities to separate out the plastics by density.

Recyclable plastics are generally separated into 7 categories, the last of which is a catchall that we will not investigate.

Learning Objectives:
At the completion of this experiment you will be able to devise a procedure to separate plastics of different density. Given the density of a solid and a liquid, you will be able predict whether the solid will sink or float.

Materials:
Containers made of the following plastics:
1 -- PETE (Polyethylene terephthalate)
2 -- HDPE (High-density polyethylene)
3 -- V (Polyvinyl chloride)
4 -- LDPE (Low-density polyethylene)
5 -- PP (Polypropylene)
6 -- PS (Polystyrene)
Solutions of the following densities: 0.9, 1.0, 1.1 and 1.3 grams/cm³.

Hazard Information:

<table>
<thead>
<tr>
<th>Density grams/cm³</th>
<th>Composition</th>
<th>Hazard Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>50% 2-propanol</td>
<td>Flammable</td>
</tr>
<tr>
<td>1.0</td>
<td>Water</td>
<td>Low hazard</td>
</tr>
<tr>
<td>1.1</td>
<td>3.5 M NaCl (aq)</td>
<td>Low hazard</td>
</tr>
<tr>
<td>1.3</td>
<td>4 M CaCl₂</td>
<td>Low hazard</td>
</tr>
</tbody>
</table>

Waste:
There is no waste from this experiment. All materials are saved for reuse.

Procedure:
Devise your own method to determine the approximate density of the plastics. You will be provided an alcohol solution, water and the two salt solutions. Plastics that sink have a density greater than the solution. Plastics that float are less dense than the solution or are being held on the very top of the solution by surface tension. Push the piece of plastic below the surface of the solution before making density observations.

CLEANUP: Screw the caps on the bottles. Rinse the pieces of plastic in water and allow them to dry.

Siena Green Chemistry Summer Institute
Lucas Tucker, Ann Klotz V2
Student Name:___________________  Date: ___________________

Procedure:
  Describe what your method for determining density of the various plastics.
Observations

Record your observations. You may use words or pictures. Organize your observation into this table.

<table>
<thead>
<tr>
<th>Plastic</th>
<th>Number</th>
<th>0.9 grams/cm³</th>
<th>1.0 grams/cm³</th>
<th>1.1 grams/cm³</th>
<th>1.3 grams/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>PETE Polyethylene Terephthalate</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HDPE High-density Polyethylene</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V Poly Vinyl Chloride</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDPE Low-density Polyethylene</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP Polypropylene</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS Polystyrene</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lab Questions

1. Which two plastics would be most difficult to separate by density? Why?

2. Why are the samples submerged rather than placed on top of the solutions?

3. Plastics 2 and 4 are both polyethylene. If these materials are made of the same polymer what is different about them?

Green Question(s)

4. Why is it important to recycle plastics?

5. What waste is generated in the experiment?

References


The American Plastics Council
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