PFAS Regulation
WHAT DOES THE FUTURE HOLD FOR CLASS I WELLS?

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PFAS ACTION PLAN - EPA FEB. 2019

- List PFOA & PFOS as CERCLA hazardous substance
- Keep PFAS out of surface & groundwater
- Develop interim cleanup levels
- ID new/additional treatment & remediation options
PATCHWORK OF STATE ACTIONS

Near Term Priorities for EPA

- Sources & levels of PFAS in environment
- Human health risks
- Develop final cleanup levels
- Understand applicable treatment & disposal options
# PFAS Treatment Options

<table>
<thead>
<tr>
<th>Treatment Method</th>
<th>PFOA</th>
<th>PFOS</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granular Activated Carbon</td>
<td>48-90%</td>
<td>89-98%</td>
<td>GAC requires replacement and disposal</td>
</tr>
<tr>
<td>Ion Exchange</td>
<td>51-90%</td>
<td>90-99%</td>
<td>Resins need to be regenerated or replaced</td>
</tr>
<tr>
<td>Membrane Filtration</td>
<td>10-50%</td>
<td>0-23%</td>
<td>Waste stream contains salts and filtrate that requires disposal</td>
</tr>
<tr>
<td>Reverse Osmosis</td>
<td>90%</td>
<td>93-99%</td>
<td>Waste stream contains salts and retentate that requires disposal</td>
</tr>
</tbody>
</table>
Landfills as PFAS Repository
## PFAS Treatment Using Reverse Osmosis

<table>
<thead>
<tr>
<th>Compound (ng/l)</th>
<th>Leachate (ng/L)</th>
<th>RO 1 Permeate (ng/L)</th>
<th>RO 2 Permeate (ng/L)</th>
<th>Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfluorobutanesulfonic acid (PFBS)</td>
<td>280</td>
<td>&lt;2</td>
<td>&lt;1.9</td>
<td>&gt;99.3%</td>
</tr>
<tr>
<td>Perfluorobutanoic acid (PFBA)</td>
<td>1100</td>
<td>5</td>
<td>&lt;1.9</td>
<td>&gt;99.8%</td>
</tr>
<tr>
<td>Perfluoroheptanoic acid (PFHpA)</td>
<td>480</td>
<td>&lt;2</td>
<td>&lt;1.9</td>
<td>&gt;99.6%</td>
</tr>
<tr>
<td>Perfluorohexanesulfonic acid (PFHxS)</td>
<td>690</td>
<td>&lt;2</td>
<td>&lt;1.9</td>
<td>&gt;99.7%</td>
</tr>
<tr>
<td>Perfluorohexanoic acid (PFHxA)</td>
<td>2100</td>
<td>7.8</td>
<td>&lt;1.9</td>
<td>&gt;99.9%</td>
</tr>
<tr>
<td>Perfluorooctanesulfonic acid (PFOS)</td>
<td>200</td>
<td>&lt;2</td>
<td>&lt;1.9</td>
<td>&gt;99.1%</td>
</tr>
<tr>
<td>Perfluorooctanoic acid (PFOA)</td>
<td>820</td>
<td>2.5</td>
<td>&lt;1.9</td>
<td>&gt;99.8%</td>
</tr>
<tr>
<td>Perfluoropentanoic acid (PFPeA)</td>
<td>880</td>
<td>2.7</td>
<td>&lt;1.9</td>
<td>&gt;99.8%</td>
</tr>
<tr>
<td>Total</td>
<td>6550</td>
<td>18</td>
<td>0</td>
<td>&gt;99.9%</td>
</tr>
</tbody>
</table>
PFAS Waste Reduction Strategy

Subtitle D
Landfill

Recirculated Leachate

Treated Leachate

Geologic Isolation

- MSW
- Industrial Waste
- WWTP Biosolids

- PFAS from various sources.
- Liquids and Solids

- Waste mass retains >90% PFAS.
- Recirculated leachate.

- Beneficial use of permeate.
- Concentrates PFAS compounds
- Reduces transport costs

Class 1 Disposal
Relative Treatment Costs

Cost Range for Different Leachate Treatment Processes

Discussion

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