Petroleum Based Solvent

What about the other Drycleaning Solvent?

South Carolina Drycleaning Restoration Trust Fund
Petroleum Based Solvents
“PBS”

✔ Gasoline: Oldest form of solvent used for drycleaning.
  – (dating back to late 1800’s).

Big problem with fires!

Early 1920’s saw experimentation with “safer” solvents.
1924, William J. Stoddard and others developed specifications for a less flammable solvent.

Specifications were “given” to the drycleaning industry. Resulting solvent named in honor of Stoddard.
“Stoddard” is a generic term for Petroleum Distillates that meet certain specifications of flash point, distillation temperature range, boiling point, corrosivity, pH, 5 other criteria.

a.k.a. “White Spirits”, “Naptha”

“Stoddard” is not a brand name. “Texsolve S” “Varsol 1” are.
Stoddard is a mix of petrochemicals that distill out between 300° and 410° F.

Typically, compounds with 7-12 Carbon atoms.
Chemical Composition

30-50%  Straight and branched chained alkanes

30-40%  Cycloalkanes

10-20%  alkyd aromatic hydrocarbons
## Chemical Composition

### Analytical testing of 3 drums of virgin solvent “Kwik Dri”

<table>
<thead>
<tr>
<th>Chemical</th>
<th>#1</th>
<th>#2</th>
<th># 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>(All results in ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sec-ButylBenzene</td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>EthylBenzene</td>
<td>11</td>
<td>2</td>
<td></td>
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<tr>
<td>p-Isopropyltoluene</td>
<td></td>
<td></td>
<td>46</td>
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<tr>
<td>Toluene</td>
<td>66</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>1,2,4 TrimethylBenzene</td>
<td></td>
<td>444</td>
<td>147</td>
</tr>
<tr>
<td>1,3,5 Trimethylbenzene</td>
<td></td>
<td>77</td>
<td>103</td>
</tr>
<tr>
<td>m&amp;p Xylene</td>
<td>463</td>
<td>61</td>
<td>26</td>
</tr>
<tr>
<td>o Xylene</td>
<td>77</td>
<td>422</td>
<td>19</td>
</tr>
</tbody>
</table>

Source: Bill Linn, FDEP
140° F Solvents

✓ Some are simply petro-chemicals collected over a smaller temperature range (360 - 390°F)

✓ Others are “synthetic” from reformulation of petro-chemicals.
  – Possibly with additives to adjust flash points.

Flashpoint ~ 140 °F
140°F Stoddard has a narrower distillation temperature range than “Regular” Stoddard.
Old machines (circa 1940’s) are common because PBS is less aggressive on steel than PCE.
Petroleum Solvent Use

✔ Estimated that ~15% of drycleaners in the USA use PBS.

✔ 40% of all drycleaning solvent sold in US may be PBS.

✔ Solvent mileage is typically less than PCE.
  ~40 lbs of clothes/ gallon PBS.

✔ Highest % of use in the South...
  – 45-50% of drycleaners in La, Mi
PBS Use in South Carolina

✔ Estimates that ~1/3 of drycleaners in state use PBS.

✔ Not Required to join the SC Drycleaning Restoration Fund if operating in 1995.

Even if the plant was using PCE or ever used PCE.
PBS Use in South Carolina

- 110 drycleaners opted out of fund (in 1995).
- Unknown # did not reply at all ...100+-
- Only 29 PBS-only drycleaners joined Fund.

-32 others joined that may have been using both PBS & PCE.
SC Statistics

- SC procedure required drycleaner to collect 1 soil sample to become eligible for fund.

  258 sites sampled. 61 of these sites were using PBS.

  188 found “something” 46 PBS sites found “something”.

  73% contaminated 75% contaminated.
Filtering database to sites that verifiably only used PBS:

- 33 sites
- 19 found “something” (57%)

Another Statistic of Interest:

- 33% of sites using PBS did not even sample for PBS compounds in their initial soil sample.

(Method 8270 not done at 17 of 50 sites).
What is found at PBS sites?

<table>
<thead>
<tr>
<th>Compounds found in</th>
<th>Detected Frequency</th>
<th>% of samples</th>
<th>Range (ug/kg)</th>
<th>DB Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perchloroethylene</td>
<td>45</td>
<td>6</td>
<td>4</td>
<td>1000</td>
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<tr>
<td>Tetrachloroethylene</td>
<td>15</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Dichloroethylene, cis 1,2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>11</td>
<td>58</td>
<td>7</td>
<td>11,000</td>
</tr>
<tr>
<td>2-Methyl Naphthalene</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>11.6</td>
</tr>
<tr>
<td>1,3,5-Trimethyl Benzene</td>
<td>11</td>
<td>58</td>
<td>7</td>
<td>11,000</td>
</tr>
<tr>
<td>Toluene</td>
<td>11</td>
<td>58</td>
<td>7</td>
<td>11,000</td>
</tr>
<tr>
<td>4-Isopropyl Toluene</td>
<td>3</td>
<td>16</td>
<td>21</td>
<td>11.6</td>
</tr>
<tr>
<td>n-Propyl Benzene</td>
<td>1</td>
<td>7</td>
<td>21</td>
<td>11.6</td>
</tr>
<tr>
<td>Isopropyl Benzene</td>
<td>1</td>
<td>7</td>
<td>21</td>
<td>11.6</td>
</tr>
</tbody>
</table>
Frequency of detection*

*Soil Samples from 33 PBS drycleaners.
Petroleum-only Drycleaners (no known PCE use)

PCE Detections vs. First Year of operation

1930’s  |  1940’s  |  1950’s  |  1960’s  |  1970’s  |  1980’s

No PCE  13/21 (62%)

PCE Detected 8/21 (38%)
Petroleum-only Drycleaners (no known PCE use)

PCE Detections vs. First Year of operation

Significant?

1930’s 1940’s 1950’s 1960’s 1970’s 1980’s

~50% of plants from 40’s, 50’s, 60’s

No PCE
Petroleum-only Drycleaners
(no known PCE use)

PCE Detections vs. First Year of operation

1930’s | 1940’s | 1950’s | 1960’s | 1970’s | 1980’s

No PCE

Not enough #’s to conclude significance.

PCE
Petroleum-only Drycleaners
(no known PCE use)

PCE Detections vs. First Year of operation

1930’s 1940’s 1950’s 1960’s 1970’s 1980’s

No PCE  PCE
Why is PCE Found at PBS-only plants?

THEORIES

Spotting agents
Why is PCE Found at PBS-only plants?

Waterproofing Dip tanks

~30 gallon tanks containing PCE & wax.

Usually dumped out when “grungy” since no PCE still at the plant.
Why is PCE Found at PBS-only plants?

Soaps: Petroleum Solvents require Petro-based soap, which are susceptible to bacteria.
PCE added to improve shelf life.
Why is PCE Found at PBS-only plants?

**THEORIES**

Anti-bacterial agent added directly to PBS:

“After the war, PCE was added to Stoddard to keep it from turning rancid. Rancid Stoddard made the clothes smell bad.”  -  *William Bell, former SC drycleaner*
Case Studies

✔ SC prioritized 302 sites & has worked on 25 high priority sites.
  – Priority system assigns toxicity and cancer weighting factors to components of PBS and PCE.
  – Big factor in priority is based on age of plant.

✔ 6 out of 25 sites worked on to date by the SC Drycleaning Fund were registered as “Petroleum only”.
  – Did not have to join fund.
Edwards Cleaners
Williston SC

Started in 1953.
Nearby Public wells.
Found PCE in soil sample.
Soil Sampling

Machine/Storage Tank

Stoddard Solvent Machine/Storage Tank

“Muck” Disposal Area
(Drycleaning Filter material)
Soil Sampling

Results: Drycleaning solvents found in soil about 5 feet deep, but nothing found at the surface.
Groundwater Sampling

Plume Concentrations:
5 to 5800 ppb PCE
15 to 97 feet deep

No PBS components found
Groundwater Sampling

Highest PCE Concentrations
20 to 40 ppb TCE
10 to 26 ppb DCE
(Because of swamp sediments... not because of PBS)
Becknell's Cleaners
Winnsboro SC

Started operating in 1965-66. Used PCE.

Switched to Petroleum Solvents in 1995.
Creek

No PBS components anywhere in plume

Free phase PCE at bedrock interface

Drycleaner

$1 million + Problem. Because of PBS use, site could have opted out of Fund.
Color Craft Cleaners
Barnwell SC

Started in 1966.
No PCE use.
Color Craft Cleaners

Solvent Tank
Soil Testing

18 soil samples tested...

1’to 25’ deep PBS components in soil samples near plant, storage tank.
Groundwater Testing

5 Monitoring wells installed at the site.
Groundwater Testing

1.3 \text{ug/L} \text{ MTBE} (gasoline anti-knock compound...)
Groundwater Testing

- 1.1 ppb PCE
- 2.6 ppb PCE
- ND
Main Street Cleaners
Marion SC

Started operating in the 1940’s.

Only used Petroleum Solvents.
Main Street Cleaners

Public Supply Wells
1 ppm PCE 1’ deep at back door.
Ground Water testing

24 wells
15 locations
Ranging from 11 to 50 feet deep
Perchloroethylene “PCE”
5 to 35 ppb
Drinking water Standard
5 ppb.

Never found again (tested 3 more times).
Naphthalene

28 ppb.

No Federal or State drinking water standard

<table>
<thead>
<tr>
<th>State</th>
<th>ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>170</td>
</tr>
<tr>
<td>MA</td>
<td>140</td>
</tr>
<tr>
<td>NJ</td>
<td>300</td>
</tr>
</tbody>
</table>
Naphthalene

Results indicate that “something else” is also causing contamination.
“BTEX”
Benzene
Toluene
Ethyl-Benzene
Xylene

NOT DRYCLEANING CHEMICALS
“BTEX”

Plumes are usually due to old leaking underground gasoline tanks.
“Pure” petroleum was collected and analyzed by a chemical forensics lab...

Lab’s Conclusion: “Pure” Petroleum is old gasoline, not Drycleaning solvent.
DeLuxe Cleaners
Williamston SC

Started in 1945.

Only used Petroleum Solvents.
Some Petroleum Solvent Chemicals were found in soil collected by boring through the concrete under the drycleaning machine.
Soil & Water Testing

7 test points followed up with 8 permanent monitoring wells

Ranging from 1 to 35 feet deep

5-21’ deep
3 wells closer to corner of East Main & Mill Street “Contaminated”

Low levels of Benzene, Toluene, & 1,2 DCA
Sample was collected and analyzed by a chemical forensics lab...

Lab’s Conclusion: Contamination is from old gasoline, not Drycleaning solvent.
Prosperity Cleaners
Prosperity SC

Started in 1947.

Only used Petroleum Solvents.
No groundwater contamination from Drycleaner,

2 plumes found from former USTs

1,2,4 TrimethylBenzene
Butyl Benzene
Case Studies Conclusion

✔ If PCE was used in a machine at the site, it could be a major site even if the switch to PBS occurred years ago.

✔ If a PCE machine was not at the site, it may not be worth looking at… based on the 4 PBS-only sites, components of PBS seem to be locked up in the soil.

But, are there environmental consequences of PBS releases?
“In most states, Stoddard Solvent is the only herbicide currently registered for use on parsley.”

– www.ces.purdue.edu

“herbicides that may be used include … Stoddard Solvent…”

– Commercial Production of Carrots in Mississippi, www.msucesares.com
Eh, What’s Up Doc?

- Recommended application rate is 60 gallons of Stoddard per acre sprayed after seedlings have emerged.
- Up to three crops per year may be grown.
- 60 gallons × 3 = 180 gallons/acre/yr.
Common in urban areas?

- Stoddard is a component of some formulations of “Cutback Asphalt, sprayed on bare earth or roadbeds prior to laying asphalt.

- Rapid Cure Cutback Asphalt is 35-45% Stoddard.
Common in urban areas?

- 35 have limits on use of Stoddard in Cutback Asphalt because of emissions.

- Some states now limit use of Cutback Asphalt to cooler months so less will evaporate off.

Figure 4.5-1. Percent of diluent evaporated from cutback asphalt over time.
But is it bad?

✔ National Toxicology Program just posted results of 2 year study inhalation testing with Stoddard on rats and mice.

But is it bad?

✔️ The State of California has recently listed naphthalene as a “Known Carcinogen”.

So, is it bad? Should Stoddard sites be in the Fund?

The jury is still out.