

# Substance Scheme

## Thermolysis Oil

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Product name: Thermolysis oil

Precursor: Tyre rubber

Production process: Pyrum-Thermolysis

|                       |                          |                                 |            |
|-----------------------|--------------------------|---------------------------------|------------|
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| <b>Revision index</b> | <b>Date</b>              | <b>Description</b>              |            |
| Version 1             | 05.07.2017               | First draft of substance scheme |            |
| Version 2             | 18.07.2017               | New Logo                        |            |
| Version 3             | 25.09.2017               | Update                          |            |
| Version 4             | 04.02.2019               | Update                          |            |
| Version 5             | 17.07.2019               | Update                          |            |
| Version 6             | 12.02.2020               | Update                          |            |
| Version 7             | 27.02.2020               | Update PAH                      |            |
| Version 8             | 12.03.2020               | Update H+P statements           |            |

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### 1 Safety information

Table 1: Relevant hazard notes for packaging and safety data sheet according to GHS

|   |   |  |   |
|---|---|--|---|
|  |  |  |  |
| H225; H226; H228  | H302; H332; H315; H319;<br>H332; H335; H336                                       | H304; H340; H350; H351;<br>H361d; H372, H373                                       | H410; H412  |

Precautionary statements: P201; P210; P261; P273; P280; P301+P312+P330; P301+P310+P331; P302+P352; P304+P340+P312; P305+P351+P338; P308+P313, P314; P331; P337+P313; P391; P501

Table 2: Recommended personal protection equipment





|   |   |  |   |
|---|---|--|---|
|  |  |  |  |
| PPE - long clothing   | Safety shoes  | Safety goggles   | Resistant gloves  |

Table 3: Relevant warning signals and prohibitions for technical applications

|   |   |  |   |
|---|---|--|---|
|  |  |  |  |
| Toxic   | Danger of explosive atmosphere  | No open flames   | Do not extinguish with water  |

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**Dangerous goods ADR/RID/AND UN1993 LAMMABLE LIQUID, N.O.S. (BENZENE, TOLUENE), ENVIRONMENTALLY HAZARDOUS**

All safety information is based on experience and is merely intended to assist and sensitize the user. It does not replace the user's risk and danger assessment in any way.

### 2 Physical properties

|                          |                                       |                    |                     |
|--------------------------|---------------------------------------|--------------------|---------------------|
| state of aggregation:    | liquid (under atmospheric conditions) |                    |                     |
| colour:                  | brown-yellow                          |                    |                     |
| pH-Wert:                 | alkaline                              |                    | DIN 38404C5         |
| density (20°C):          | 800 - 1000                            | kg/m <sup>3</sup>  | DIN EN ISO 3838     |
| gross calorific value:   | 30 - 45                               | MJ/kg              | DIN EN 15400        |
| kin. viscosity at 60 °C: | < 2,0                                 | mm <sup>2</sup> /s | EN ISO 3104         |
| dyn. viscosity at 60 °C: | > 1,5                                 | mPas               | ASTM D7042          |
| flash point:             | < 5                                   | °C                 | DIN EN ISO 3679     |
| Ignition temperature:    | > 200                                 | °C                 |                     |
| Boiling range            | 36 - 560                              | °C                 | ASTM D2887 Extended |

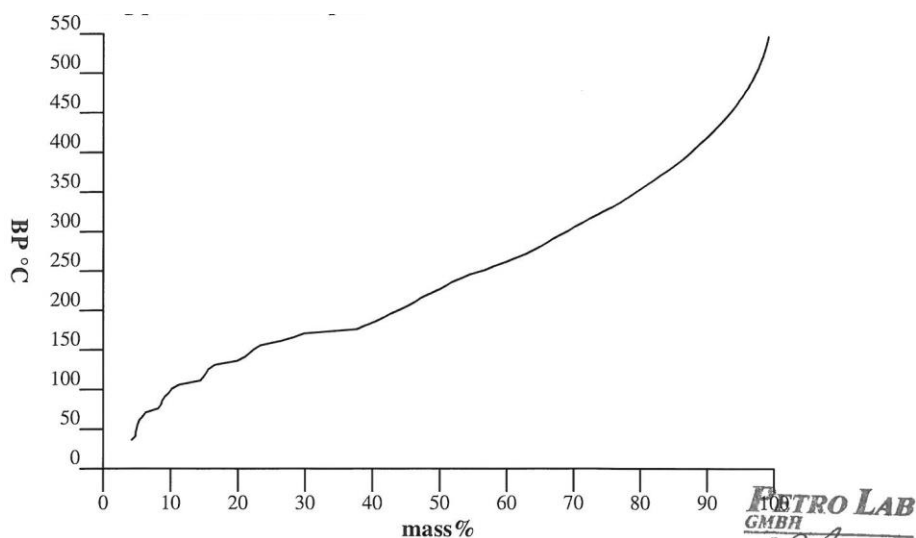


Figure 1: Boiling point distribution by simulated distillation in accordance with ASTM D2887 Ext.

The proportions of the boiling fractions are shown in Figure 1.

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### 3 Chemical properties

- Corrosive towards non-passified steel
- Dissolves polystyrene
- Expands many plastics

### 4 IR-Spectroscopy

#### 4.1 Method description

The qualitative IR analysis was carried out via (ATR) IR spectroscopy.

Spectrometer: Alpha with sample compartment RT-DLaTGS, Bruker  
Accessory: ATR platinum Diamond 1 Refl  
Software: OPUS 7.5

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### 4.2 Results

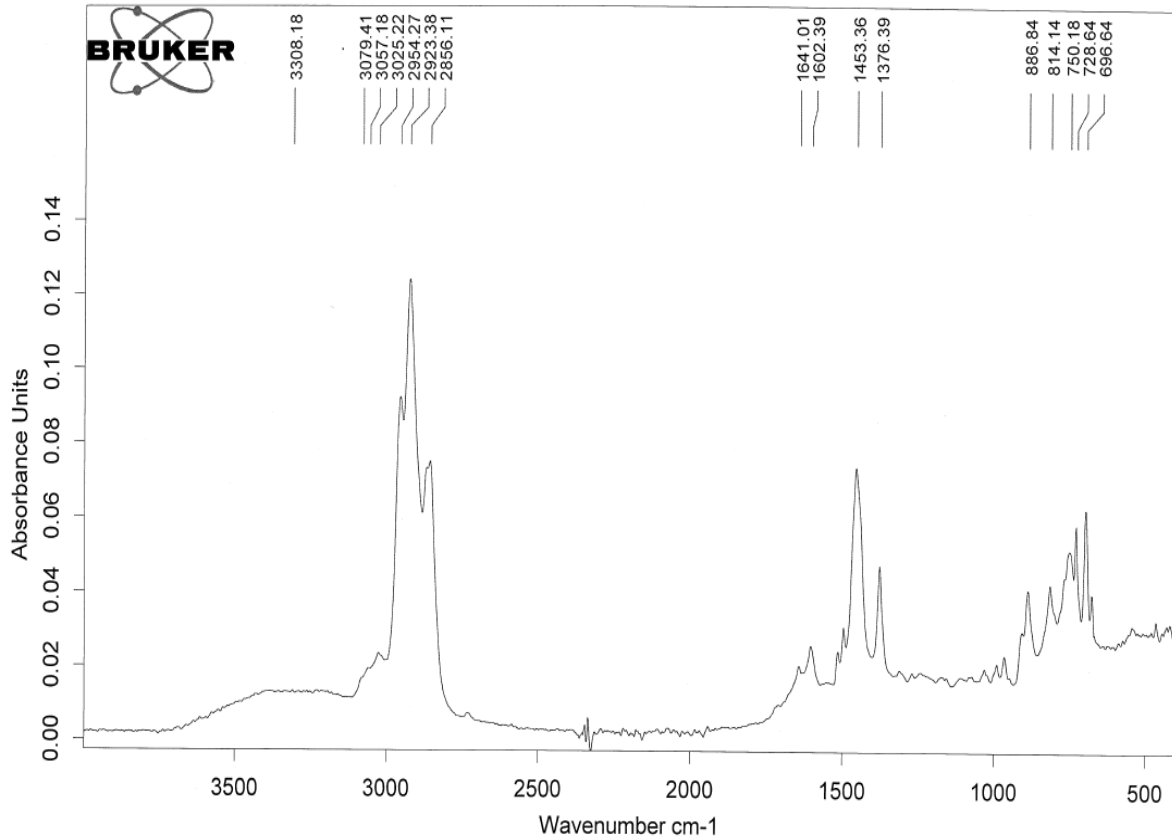


Figure 2: IR-spectrum of the pyrolysis oil

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Table 4: Typical bands of the pyrolysis oil

| Wavenumber (cm <sup>-1</sup> ) | Structural unit                                  |
|--------------------------------|--|
| 3057.18                        | =C-H (Stretching, Olefine)                       |
| 3025.22                        | =C-H (Stretching, Aromaten)                      |
| 2954.27                        | CH <sub>3</sub> (Stretching)                     |
| 2923.38                        | CH <sub>2</sub> (Stretching)                     |
| 2856.11                        | CH (Stretching)                                  |
| 1641.01                        | C=C (Stretching, Olefine)                        |
| 1602.39                        | C=C (Stretching, Aromaten)                       |
| 1453.36                        | CH <sub>3</sub> , CH <sub>2</sub> , CH (Bending) |
| 1376.39                        | CH <sub>3</sub> (Bending)                        |
| 990-660                        | =C-H (Bending, Olefine)                          |
| 900-600                        | C-H (Bending, Aromaten)                          |

The IR spectrum showed the expected absorptions according to the sample composition. Both aromatics and saturated and unsaturated aliphatic hydrocarbons were detected.

Table 5: Experience based values for the chemical stability of chosen substances toward thermolysis oil; good chem. stability (+); moderate chem. stability (o); low to no chem. stability (-)

| Material                                    | Stability | Long term stability |
|---|-----------|---------------------|
| Stainless steel: 1.4571, 1.4828, or similar | +         | affirmative         |
| Graphite (e.g. in flat gasket)              | +         | affirmative         |
| NBR   | -         |                     |
| Polystyrene                                 | -         |                     |
| Oxime-silicone                              | o         | n.e.                |
| PTFE  | +         | affirmative         |
| Copper                                      | +         | affirmative         |
| S235JR (construction steel)                 | -         | Prone to corrosion  |

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### 5 Physiological properties

Odour: sent of mineral oil, sulfidic

Toxicity: see table 1 and chapter 8

### 6 Composition

#### 6.1 Components

Table 6: Components of the oil

| Components                 | Substance group |
|----------------------------|-----------------|
| Aromatics Hydrocarbons     | Mono-aromatics  |
|                            | Di-aromatics    |
|                            | Tri+-aromatics  |
|                            | Polyaromatics   |
| Non aromatics Hydrocarbons | Paraffins       |
|                            | Mono-Naphtenics |
|                            | Di-Naphtenics   |
|                            | Cycloalkenes    |
|                            | Others          |

#### 6.1.1 Single Components

Table 7 Mono Aromatics

| Substance    | DIN Norm         |
|--------------|------------------|
| Benzene      | DIN EN ISO 22155 |
| Toluene      | DIN EN ISO 22155 |
| Ethylbenzene | DIN EN ISO 22155 |
| Xylene       | DIN EN ISO 22155 |
| Styrene      | DIN EN ISO 22155 |



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The biggest parts of the oil are aromatic compounds, olefins and paraffins. The chain length proportions were shown in figure 9.

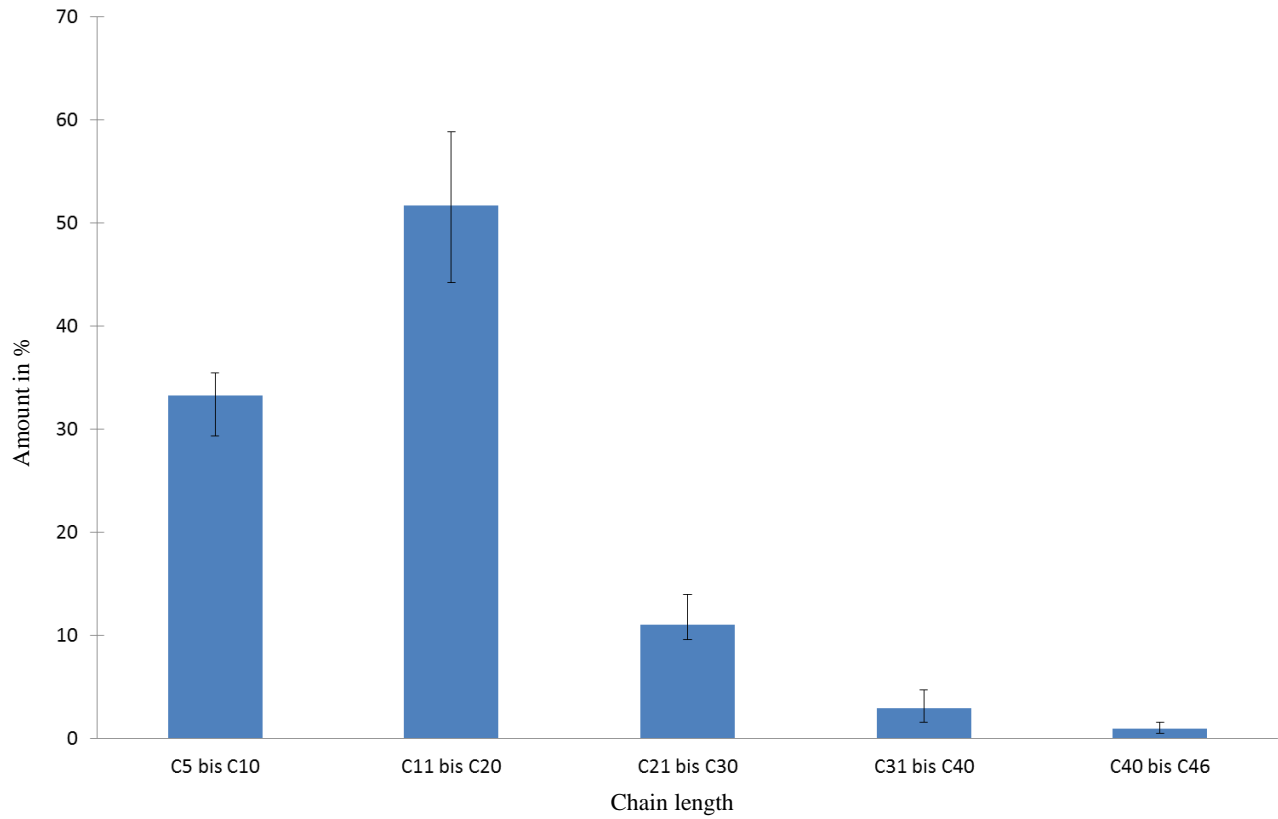


Figure 9: Content depending on the chain length

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Table 8 Polycyclic aromatic hydrocarbons (PAH)

| Substanz                   | Norm          |
|----------------------------|---------------|
| Napthaline                 | DIN 38407-F39 |
| Acenaphthylene             | DIN 38407-F39 |
| Acenaphthene               | DIN 38407-F39 |
| Fluorene                   | DIN 38407-F39 |
| Phenanthrene               | DIN 38407-F39 |
| Anthracene                 | DIN 38407-F39 |
| Fluoranthene               | DIN 38407-F39 |
| Pyrene                     | DIN 38407-F39 |
| Benzo(a)anthracene         | DIN 38407-F39 |
| Chrysene                   | DIN 38407-F39 |
| Benzo(b)fluoranthene       | DIN 38407-F39 |
| Benzo(k)fluoranthene       | DIN 38407-F39 |
| Benzo(a)pyrene             | DIN 38407-F39 |
| Indeno(1, 2, 3-c, d)pyrene | DIN 38407-F39 |
| Dibenzo(a, h)anthracene    | DIN 38407-F39 |
| Benzo(g, h, i)perylene     | DIN 38407-F39 |

## 6.2 Nuclear composition

Table 9 Composition

| Element | Content   | Analysis             |
|---------|-----------|----------------------|
| C       | > 80%     | Elementary analysis  |
| H       | > 8%      | Elementary analysis  |
| N       | < 1%      | Elementary analysis  |
| S       | < 1%      | Elementary analysis  |
| Cl      | < 10mg/kg | Altöl Anlage 2 Nr. 3 |

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### 6.3 Impurity

|               |         |                  |
|---------------|---------|------------------|
| Water:        | < 0,4 % | DIN EN ISO 12937 |
| Carbon Black: | < 1g/l  | DIN EN 12662     |

## 7 Examples for application

- Fuel for asphalt burner
- Crude oil supplement for usage in refineries
- Fuel in general for generation of energy

## 8 Hazard and precautionary statements

### 8.1 Relevant hazard warnings

|       |  |
|-------|--|
| H225  | Highly flammable liquid and vapour.                                |
| H226  | Flammable liquid and vapour.                                       |
| H228  | Flammable solid.   |
| H302  | Harmful if swallowed.  |
| H304  | May be fatal if swallowed and enters airways.                      |
| H315  | Causes skin irritation.  |
| H319  | Causes serious eye irritation.                                     |
| H332  | Toxic if inhaled.  |
| H335  | May cause respiratory irritation.                                  |
| H336  | May cause drowsiness or dizziness.                                 |
| H340  | May cause genetic defects.   |
| H350  | May cause cancer.  |
| H351  | Suspected of causing cancer.                                       |
| H361d | Suspected of damaging fertility or the unborn child.               |
| H372  | Causes damage to organs through prolonged or repeated exposure.    |
| H373  | May cause damage to organs through prolonged or repeated exposure. |
| H410  | Very toxic to aquatic life with long lasting effects.              |

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H412 Harmful to aquatic life with long lasting effects.

### 8.2 Relevant precautionary information

P201 Obtain special instructions before use.

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources.  
No smoking.

P273 Avoid release to the environment.

P280 Wear protective gloves/protective clothing/eye protection/face protection.

P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

P301+P312+P330 IF SWALLOWED Call a POISON CENTER/ doctor if you feel unwell.

P302+P352 IF ON SKIN: Wash with plenty of water

P304+P340+P312 If swallowed: rinse mouth. Do NOT induce vomiting.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.

P308+P313 IF EXPOSED OR CONCERNED: Get medical advice/attention.

P314 Get medical advice/attention if you feel unwell

P331 Do not induce vomiting.

P337+P313 If eye irritation persists get medical advice/attention.

P391 Collect spillage.

P501 Dispose of contents/container to waste disposal facility