Substance Scheme
Thermolysis Oil

Product name:	Thermolysis oil
Precurser:	Tyre rubber
Production process:	Pyrum-Thermolysis

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Revision index	Date	Description
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

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1 Safety information

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

			
H225; H226; H228	H312; H315; H319; H332; H335; H336	H340; H350; H351; H361d; H373	H400; H410; H411; H412

Precautionary statements: P201; P210; P260; P261; P273; P280; P301+P310; P301+P312; P304+P340+P312P304+P340+P312; P331; P370+P378; P391; P403+P235; 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

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 sensibilize 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):	< 1000	kg/m³	pycnometric
gross calorific value:	> 30	MJ/kg	DIN EN 15400
kin. viscosity at 60 °C:	> 2,0	mm²/s	NF RN ISO3104
dyn. viscosity at 60 °C:	> 1,5	mPas	ASTM D7042
flash point:	< 23	°C	Pensky Martens, DIN51755, EN22719
Ignition temperature:	> 200	°C	

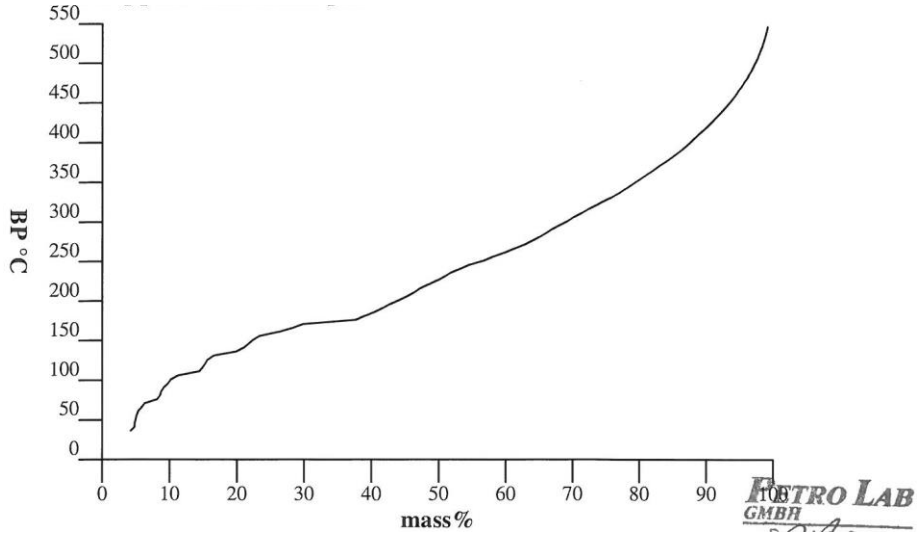

Figure 1: Boiling point distribution by simulated distillation in accordance with ASTM D2887 Ext.

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

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

4.2 Results

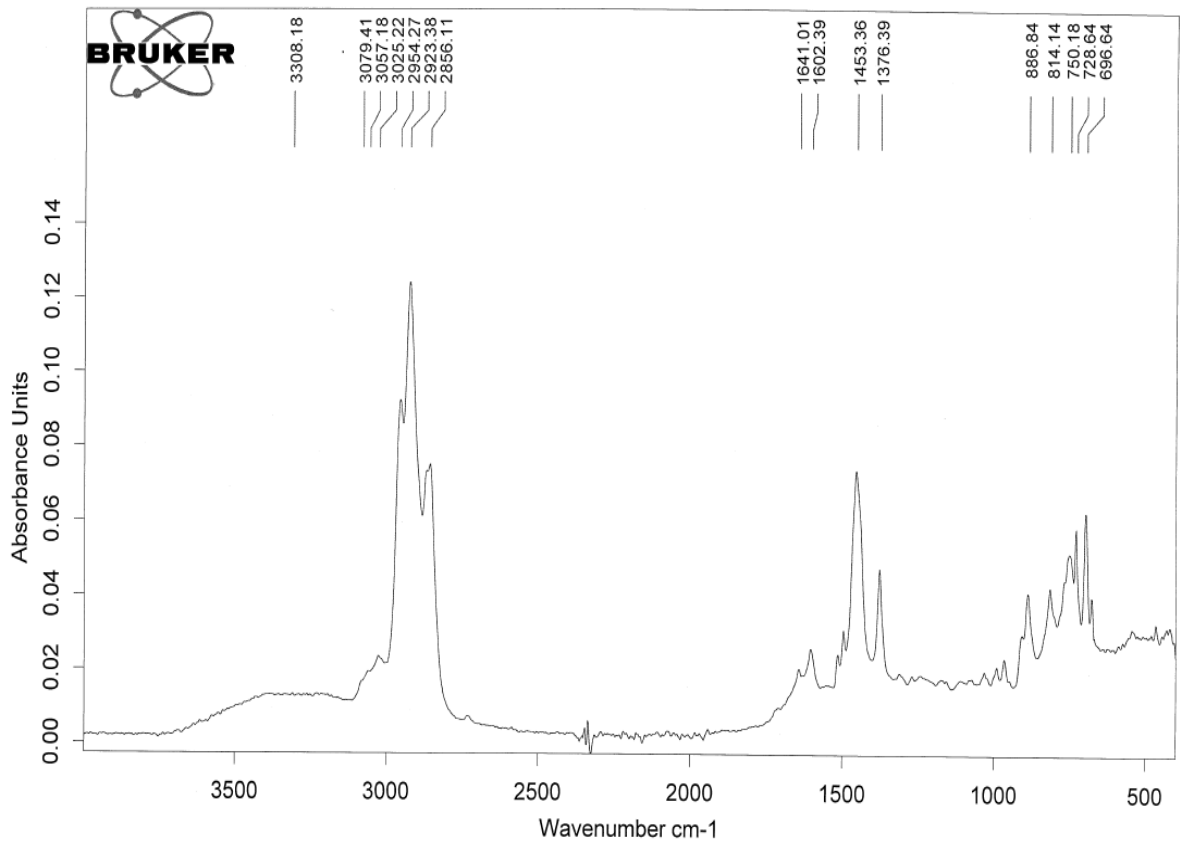

Figure 2: IR-spectrum of the pyrolysis oil

Table 4: Typical bands of the pyrolysis oil

Wavenumber (cm^{-1})	Structural unit
3057.18	=C-H (Stretching, Olefine)
3025.22	=C-H (Stretching, Aromaten)
2954.27	CH_3 (Stretching)
2923.38	CH_2 (Stretching)
2856.11	CH (Stretching)
1641.01	C=C (Stretching, Olefine)
1602.39	C=C (Stretching, Aromaten)
1453.36	CH_3, CH_2, CH (Bending)
1376.39	CH_3 (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

5 Physiological properties

Odour: sent of mineral oil, sulfidic

Toxicity: see table 1 and chapter 8

6 Composition

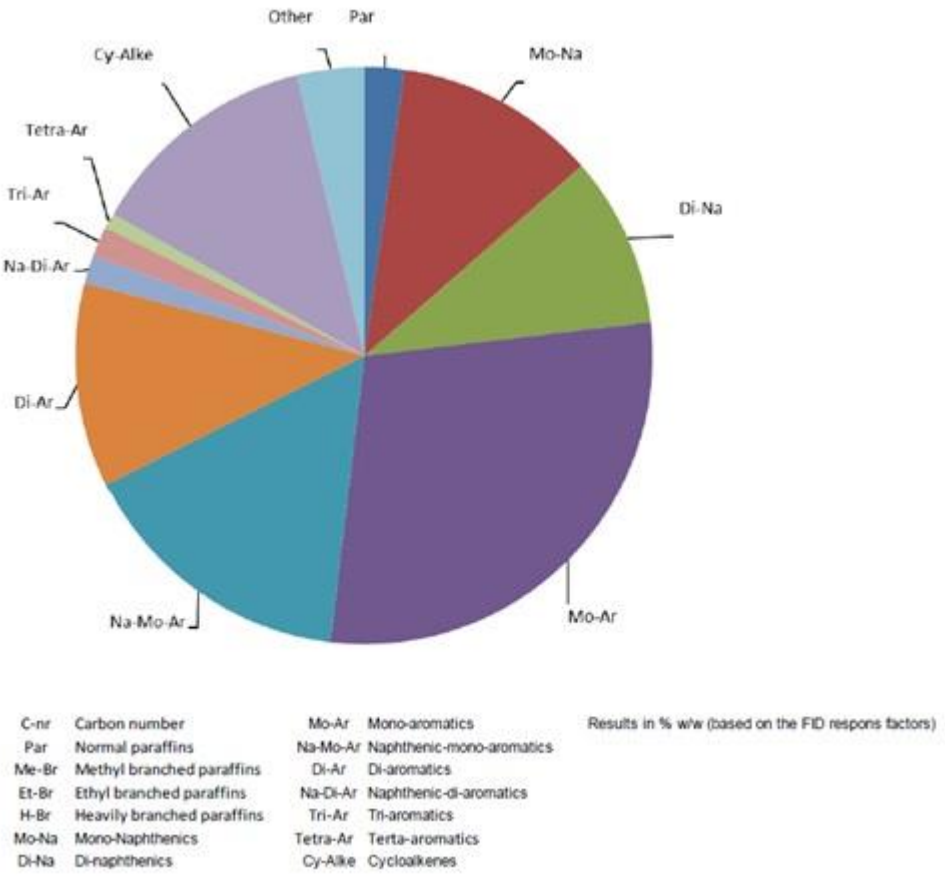

Figure 3: Composition of the thermolysis oil

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-Napthenics
	Cycloalkenes
	Others

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

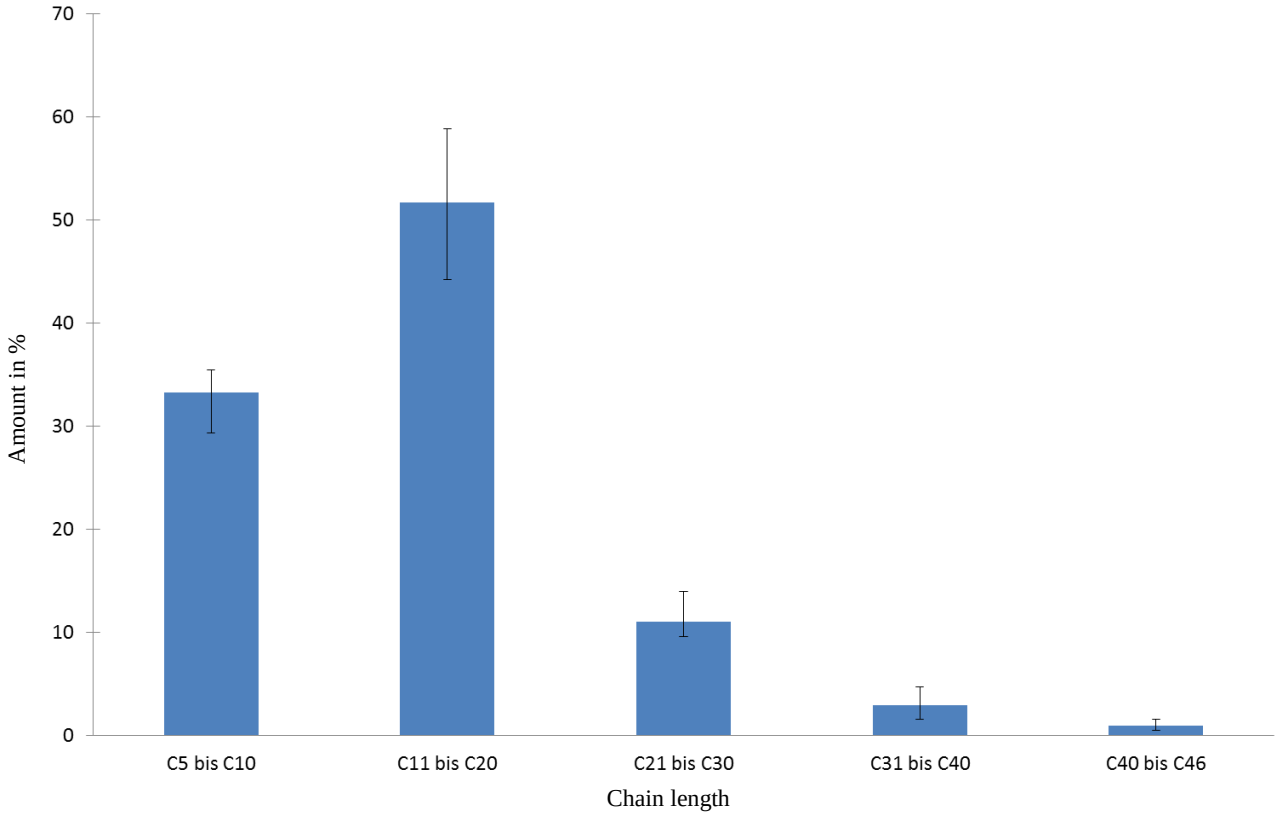

Figure 9: Content depending on the chain length

Table 7: Content of polycyclic aromatic hydrocarbons (PAH)

Polycyclic aromatics hydrocarbons	**DIN EN Norm**
Naphthalene:	DIN EN 15527
Acenaphthylene:	DIN EN 15527
Acenaphthene:	DIN EN 15527
Fluorene:	DIN EN 15527
Phenanthrene:	DIN EN 15527
Anthracene:	DIN EN 15527
Fluoranthene:	DIN EN 15527

Pyrene:	DIN EN 15527
Benz(a)anthracene:	DIN EN 15527
Chrysene:	DIN EN 15527
Benzo(b)fluoranth	DIN EN 15527
Benzo(k)fluoranth	DIN EN 15527
Benzo(a)pyrene:	DIN EN 15527
Indeno(1,2,3-c,d)pyrene	DIN EN 15527
Dibenzo(a,h)anthr.:	DIN EN 15527
Benzo(g,h,i)perylene	DIN EN 15527

6.2 Nuclear composition

Carbon is the main component of the thermolyis oil. Its concentration is > 80 wt.%.

6.3 Impurity

Water: possible in low quantaties

Carbon Black: possible in low quantities

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.
H312	Harmful in contact with skin.
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.
H361	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.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
H411	Toxic to aquatic life with long lasting effects.
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.
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P301+P310	If swallowed: Immediately call a POISON CENTER/ doctor
P301+P312+P330	If swallowed: Call a POISON CENTER/ doctor if you feel unwell.
P304+P340+P312	If swallowed: rinse mouth. Do NOT induce vomiting.
P308+P313	If exposed or concerned: Get medical advice/attention.

P331	Do not induce vomiting.
P370+P378	In case of fire: Use extinguishing powder to extinguish.
P391	Collect spillage.
P403+P235	Store in a well ventilated place. Keep cool.
P501	Dispose of contents/container to waste disposal facility