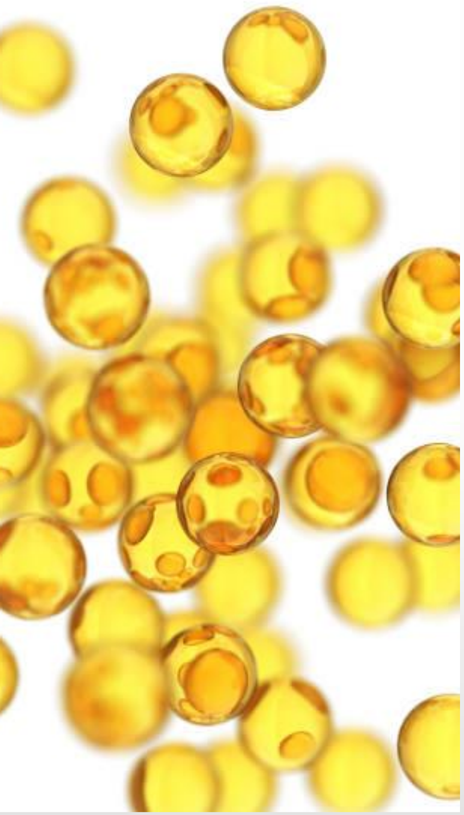
OUR TECHNOLOGIES FOR FEEDSTOCK PRE-TREATMENT



ORGANIC DECHLORINATION

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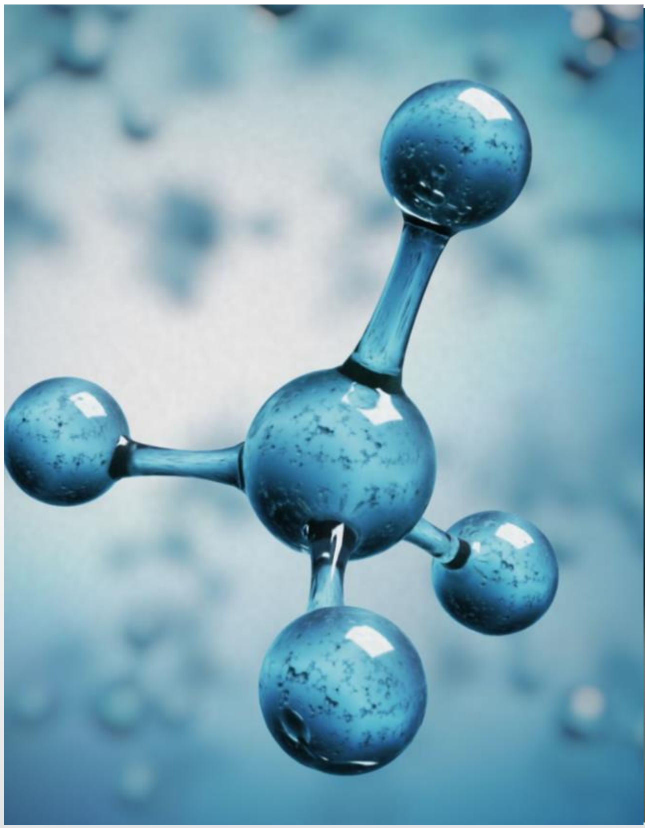


IMPORTANCE OF OIL PRE-TREATMENT

A crucial step of HVO Production is Oil Pre-treatment prior to Hydrotreatment.

In order to correctly feed the HVO plant it is compelling to remove undesirable elements from any feedstock that may be used, **especially in case of waste oils and fats.**

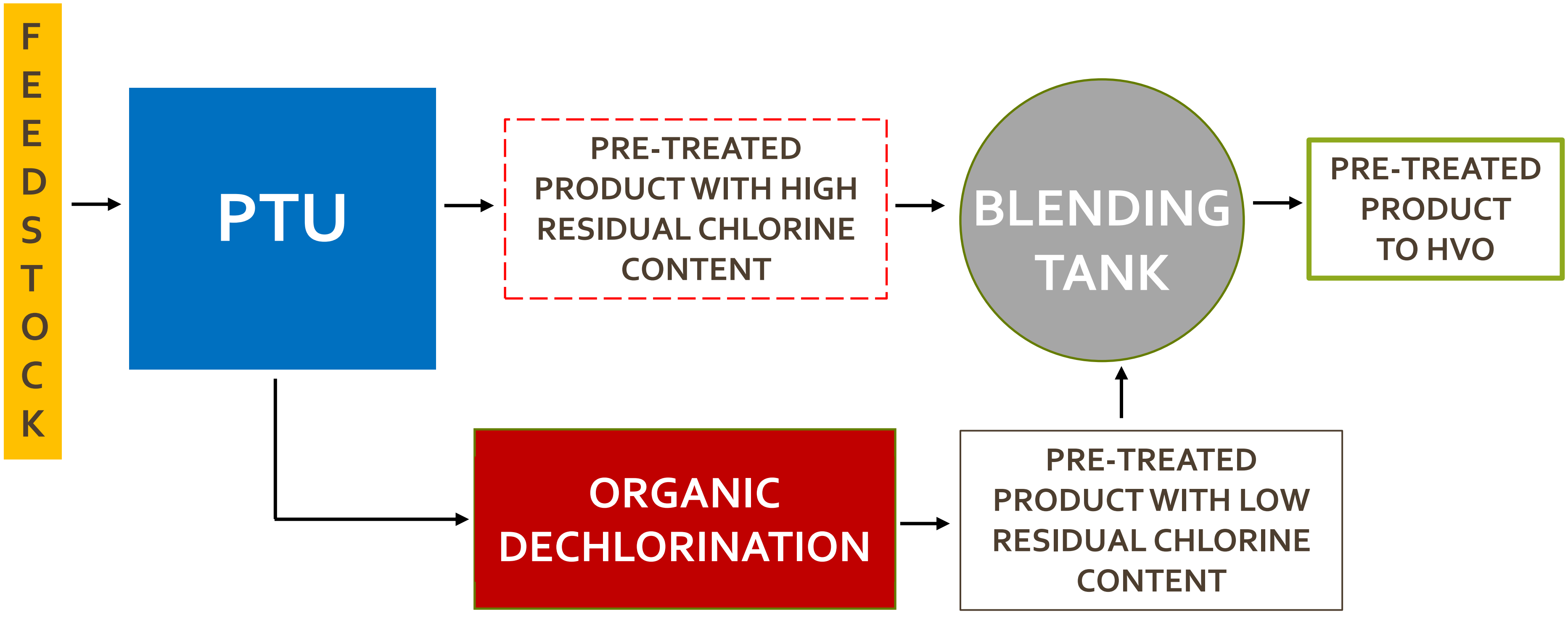
TECHNOILOGY manufactures plants for vegetable and non-vegetable feedstock Pre-treatment. **We can remove all contaminants and undesirable content**
that could lead to the poisoning of catalysts or not suitable for the metallurgic materials of HVO plants.

Organic chlorine removal is one of the most challenging step of waste oil Pre-treatment.
TECHNOILOGY has developed a unique process to deeply remove the organic chlorine contained in organic substrates.

We have named this process **ORGANIC DECHLORINATION** as it is focused on chlorine removal, but it is also effective on Phosphorous and organic Sulfur removal.

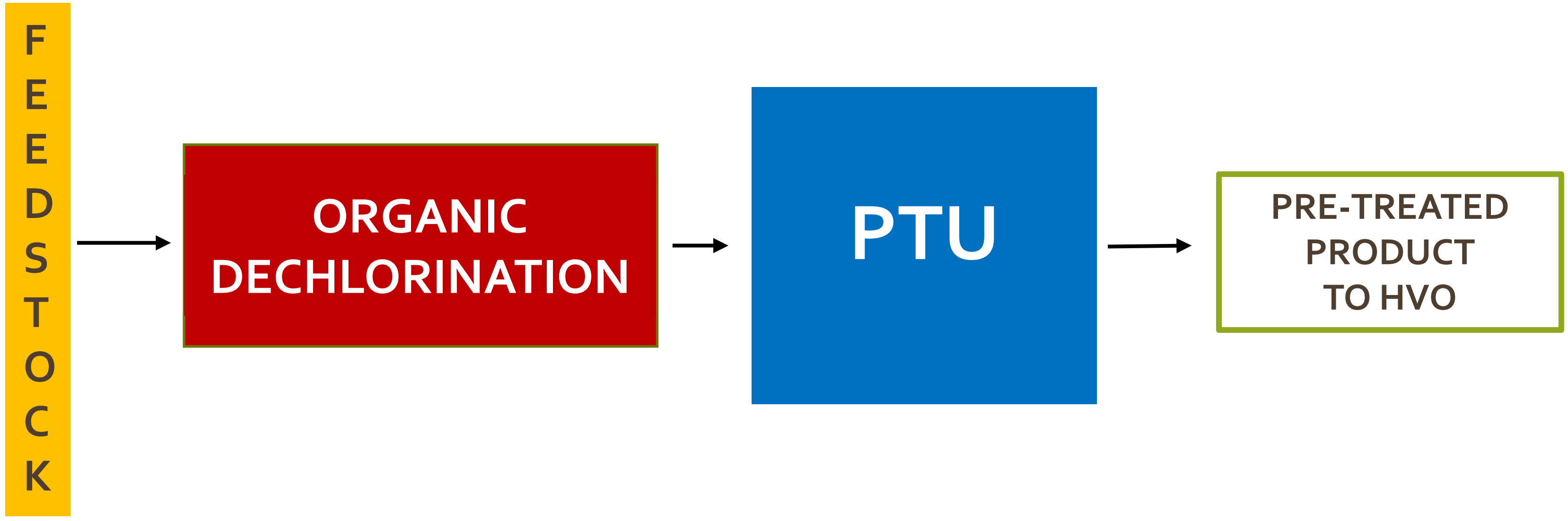
ORGANIC DECHLORINATION: HOW TO PLACE IT IN THE PTU

ORGANIC DECHLORINATION can be placed as **last step** of the PTU (Pre-Treatment Unit) and sized with a capacity suitable for the mixing of pretreated charges with high residual chlorine value.



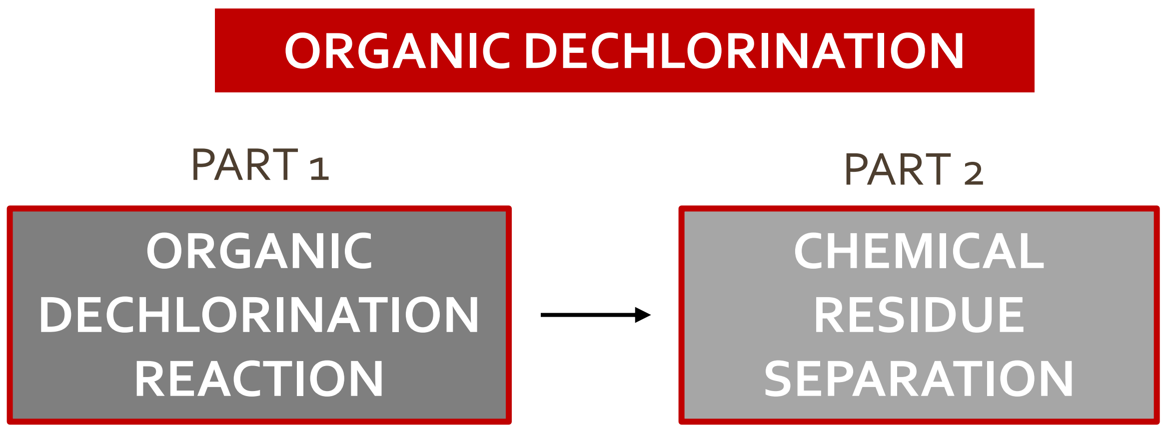
ORGANIC DECHLORINATION: HOW TO PLACE IT IN THE PTU

ORGANIC DECHLORINATION can be placed as **first step** of the PTU (Pre-Treatment Unit), in order to exploit the chlorine removal capacity, together with the strong reduction of phosphorus and sulfur.



ORGANIC DECHLORINATION: HOW IT IS COMPOSED

ORGANIC DECHLORINATION is composed of **2 main parts**: a 1st part where reaction takes place and a 2nd part related to the removal of residue of dechlorination chemicals by hot water washing with centrifugal separators.



If **ORGANIC DECHLORINATION** is installed downstream PTU a single or double washing stage is needed to remove any traces of dechlorination chemicals together with chlorine residue.

If **ORGANIC DECHLORINATION** is installed upstream PTU, only reaction step is needed: the removal of dechlorination chemicals together with chlorine residue is left at the Degumming and Bleaching stages.

ORGANIC DECHLORINATION CHEMICALS

TECHNOILOGY has identified 3 (three) different families of chemicals able to remove Chlorine from organic substrates.
As said earlier, each one of them has been selected for Chlorine removal but also have a strong action on P and S removal.

We identify each family as Catalyst Type 1, 2 and 3 to not disclose them during patenting process.

Catalyst type 1 was developed a few years ago for 3-MCPD mitigation in RBD Palm Oil and then applied with success on any lipidic feedstock.

Catalyst type 2 and 3 are especially dedicated to any Pyrolysis oil and tall oil derivatives.

The following slides show the data collected for both lipidic feedstock and pyrolysis oil during the trials executed in our lab.

TRIALS ON LIPIDIC FEEDSTOCK

	Oil 1	Oil 1	Oil 1
	Technoilogy Analysis	Customer Analysis	Technoilogy analysis after chemical treatment
Na	45		1,1
Mg	<4,0	<5	2,1
Al	<1,5		< detect limits
Si	13,1	<1	0,6
P	0,42	<1	< detect limits
S	22,1		5,6
Cl	21,6	23,4	2,0
K	1,9		0,7
Ca	6,6	<5	< detect limits
Ti	<0,3		< detect limits
V	0,6		<0,1
Cr	0,6		<0,1
Mn	<0,5	2	< detect limits
Fe	1,9	<1	<1
Co	<1,0		< detect limits
Ni	<0,3		< detect limits
Cu	<0,2	<1	< detect limits
Zn	<0,1		< detect limits
Zr	<0,3		< detect limits
Mo	0		< detect limits
Ag	<0,7		< detect limits
Cd	<0,2		< detect limits
Sn	<0,3		< detect limits
Sb	<0,2		< detect limits
Ba	0,9	1	< detect limits
W	<0,3		< detect limits
Pb	0,13		< detect limits

	Oil 2	Oil 2	Oil 2
	Technoilogy Analysis	Customer Analysis	Technoilogy analysis after chemical treatment
Na	573	238	< detect limits
Mg	236,2		< detect limits
Al	67,4		< detect limits
Si	217	265	6,3
P	101,3	109	0,3
S	133,2		65,5
Cl	27,8	24,3	1,1
K	3856	>1000	2,6
Ca	117,4	127	1,3
Ti	5,5	7	0,2
V	<0,2	<1	< detect limits
Cr	<0,4	0,5	< detect limits
Mn	6,4	11	0,6
Fe	166,7	189	2,3
Co	0,6		< detect limits
Ni	<0,3	<1	< detect limits
Cu	<0,2	2	< detect limits
Zn	2,4	3	< detect limits
Zr	0,5		< detect limits
Mo	0		< detect limits
Ag	<0,7		< detect limits
Cd	0,9		< detect limits
Sn	<0,3		< detect limits
Sb	<0,4		< detect limits
Ba	3,9	3	2,1
W	<0,3		
Pb	0,2		< detect limits

	Oil 3	Oil 3	Oil 3
	Technoilogy Analysis	Customer Analysis	Technoilogy analysis after chemical treatment
Na	80	1,5	< detect limits
Mg	<4,0	<2,5	1,1
Al	<1,5		< detect limits
Si	27,8	15	2,4
P	1	<2,5	< detect limits
S	110,1	107,5	23,8
Cl	20,3	19	2,8
K	85,5	<2,5	3,7
Ca	3,8		< detect limits
Ti	<0,3	<2,5	< detect limits
V	7,0	<2,5	0,5
Cr	0,5	<2,5	< detect limits
Mn	0,8	<2,5	< detect limits
Fe	3,3		< detect limits
Co	0,2		1,5
Ni	<0,3	<2,5	< detect limits
Cu	<0,2		< detect limits
Zn	<0,1	<2,5	< detect limits
Zr	<0,3		< detect limits
Mo	0		< detect limits
Ag	<0,7		< detect limits
Cd	<0,2		< detect limits
Sn	<0,3	<2,5	< detect limits
Sb	<0,4		< detect limits
Ba	1,1	<2,5	< detect limits
W	<0,3		< detect limits
Pb	<0,1	<2,5	< detect limits

	Oil 4	Oil 4	Oil 4
	Technoilogy Analysis	Customer Analysis	Technoilogy analysis after chemical treatment
Na	<8,1	<2,5	< detect limits
Mg	<4,8	<2,5	< detect limits
Al	<1,7	<2,5	< detect limits
Si	7,9	<1	1,5
P	<0,2	<2,5	< detect limits
S	19,9	7,9	1,3
Cl	583,9	613	142
K	1,5		1,4
Ca	3,9	<2,5	< detect limits
Ti	<0,3	<2,5	< detect limits
V	0,3	<2,5	< detect limits
Cr	<0,1	<2,5	< detect limits
Mn	0	<2,5	< detect limits
Fe	2,2	<2,5	1,3
Co	<1,0		< detect limits
Ni	<0,4	<2,5	< detect limits
Cu	<0,2	<2,5	< detect limits
Zn	<0,1	<2,5	< detect limits
Zr	<0,3		< detect limits
Mo	0		< detect limits
Ag	<0,7		< detect limits
Cd	1,0		< detect limits
Sn	<0,3	<2,5	< detect limits
Sb	<3,2		< detect limits
Ba	1,9		< detect limits
W	<0,3		< detect limits
Pb	<0,3	<2,5	< detect limits

TRIALS ON PYROLYSIS OIL AND TALL OIL DERIVATES

Name	Sample 1	Sample 1	Sample 1	Sample 1	Sample 1
Sample	Pyrolysis oil from RDF1	Pyrolysis oil from RDF1	Catalyst Type 1	Catalyst Type 2	Catalyst Type 3
	CUSTOMER ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS
Sulfur content (ppm)	104	128	94,0	32,5	69,6
Chlorine content (ppm)	318	293,3	105	89,5	26,3
Metals content (ppm)					
Al	<1	<1,6	<1,6	<1,6	<1,6
Ba	<1	1,8	2,0	1,0	1,0
Cd	<1	<1	<0,9	<0,9	<0,9
Ca	127,0	117,0	<0,3	1,1	<0,3
Zn	185,0	190,0	<0,1	1	1,3
Cu	<1	<0,2	<0,2	<0,2	<0,2
Cr	<1	<0,5	<0,4	<0,4	<0,4
Sn	<1	<2	<0,3	<0,3	<0,3
P	9,8	6,4	6,0	2,5	0,3
Fe	20,2	24,3	0,7	0,8	0,7
Mg	<1	<1	<1	<1	<1
Mn	<1	<0,6	<0,6	<0,6	<0,6
Mo	<1	<0,5	0,0	0,0	0,0
Ni	<1	<0,2	<0,2	<0,2	<0,2
Ag	<1	<0,7	<0,7	<0,7	<0,7
Pb	<1	0,3	0,1	0,3	0,3
K	<1	2,2	<0,5	0,5	0,6
Si	12,1	131,5	<0,3	<0,3	<0,3
Na	4,7	<1	<1	<1	<1
Ti	<1	<0,3	<0,3	<0,3	<0,3
V	<1	0,8	<0,3	<1	<0,4

TRIALS ON PYROLYSIS OIL AND TALL OIL DERIVATES

Name	Sample 2	Sample 2	Sample 2	Sample 2	Sample 2
Sample	Pyrolysis oil from RDF2	Pyrolysis oil from RDF2	Catalyst Type 1	Catalyst Type 2	Catalyst Type 3
	CUSTOMER ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS
Sulfur content (ppm)	530	420	307	281	244
Chlorine content (ppm)	355,2	331,1	195,4	145,0	52,0
Metals content (ppm)					
Al	<1	<1,7	<1,6	<1,6	<1,6
Ba	<1	<1	<1	<1	<1
Cd		<1	<1	<1	<1
Ca	18,0	140,8	1,1	0,5	1,0
Zn	100,0	181,7	0,9	0,8	<0,1
Cu	<1	<0,3	<0,2	<0,2	<0,2
Cr	<1	<0,1	<0,1	<0,1	<0,1
Sn	<1	96,7	9,0	20,2	27,8
P	2,3	3,0	2,6	2,6	<0,1
Fe	43,0	570,2	0,6	0,9	0,7
Mg	<1	<1	<1	<1	<1
Mn	<1	0,0	0,0	0,0	0,0
Mo	<1	0,0	0,0	0,0	0,0
Ni	<1	<0,2	<0,2	<0,2	<0,2
Ag	<1	<0,7	<0,7	<0,7	<0,7
Pb	<1	0,3	<0,1	<0,1	<0,1
K	<1	3,5	<0,5	0,5	0,6
Si	6,0	318,6	<0,3	<0,3	<0,3
Na	<1	<1	<1	<1	<1
Ti	<1	<0,3	<0,3	<0,3	<0,3
V	<1	<0,2	<0,2	<0,2	<0,2

TRIALS ON PYROLYSIS OIL AND TALL OIL DERIVATES

Name	Sample 3	Sample 3	Sample 3	Sample 3	Sample 3
Sample	Tall Oil Derivates	Tall Oil Derivatives	Catalyst Type 1	Catalyst Type 2	Catalyst Type 3
	CUSTOMER ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS
Sulfur content (ppm)	6200	6264	4317	5445	**5033**
Chlorine content (ppm)	**139**	**81,4**	**60,2**	**73,5**	**28,8**
Metals content (ppm)					
Al	<1	<1	<1	<1	<1,6
Ba	<1	0,8	<1	<1	<1
Cd	<1	<0,9	<0,9	<0,9	<1
Ca	1,4	4,2	0,5	0,5	<0,4
Zn	<1	<0,1	<0,1	29	<0,1
Cu	<1	<0,3	<0,2	<1	<0,2
Cr	<1	<0,3	<0,4	<0,5	<0,1
Sn	<1	6,2	5,9	0,3	4,5
P	<2	0,9	0,6	0,2	0,1
Fe	78,0	71,3	0,9	1,9	1,2
Mg	<1	<1	<1	<1	<1
Mn	<1	0,0	0,0	0,0	0,0
Mo	<1	0,0	0,0	0,0	0,0
Ni	<1	<0,3	<0,3	<0,3	<0,2
Ag	<1	<0,7	<0,7	<0,7	<0,7
Pb	<1	<0,1	<0,1	<0,1	<0,1
K	<1	1,4	0,6	0,6	1,0
Si	210,0	238	<0,3	<0,3	<0,3
Na	190,0	180,0	<1	<1	<1
Ti	<1	<0,3	<0,3	<0,3	<0,3
V	<1	<0,2	<0,2	<0,2	<0,2

TRIALS ON PYROLYSIS OIL AND TALL OIL DERIVATES

Name	Sample 4	Sample 4	Sample 4	Sample 4	Sample 4
Sample	Pyrolysis oil from plastics	Pyrolysis oil from plastics	**Catalyst Type 1**	**Catalyst Type 2**	**Catalyst Type 3**
	CUSTOMER ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS	TECHNOILOGY ANALYSIS
Sulfur content (ppm)	76	56,8	47,5	43,5	**41,0**
Chlorine content (ppm)	**140,8**	**113,1**	**60,0**	**58,2**	**0,7**
Metals Content (ppm)					
Al	<0,4	<1,6	<1,6	<1,6	<1,6
Ba	<0,05	<1	<1	<1	<1
Cd	<0,03	<1	<1	<1	<1
Ca	<0,1	7,8	0,3	0,3	<1
Zn	0,1	<0,3	<0,3	<0,1	<0,1
Cu	<0,1	<0,2	<0,2	<0,2	<0,2
Cr	<0,1	<0,4	<0,4	<0,4	<0,1
Sn	65,0	59,5	2,2	<0,3	4,5
P	24,0	23,4	1,5	1,4	0,1
Fe	101,0	103,7	4,1	2,7	5,0
Mg	<0,02	<5	<4	<4	<4,5
Mn	<0,02	0,0	0,0	0,0	0,0
Mo	<0,2	0,0	0,0	0,0	0,0
Ni	<0,08	<0,2	<0,2	<0,2	<0,2
Ag	<0,08	<0,6	<0,6	<0,6	<0,7
Pb	<0,4	<0,1	<0,1	<0,1	<0,1
K	<1,1	1,7	<0,5	<0,5	<1
Si	17,2	768,3	2,1	1,5	1,7
Na	1,4	1,7	<1	<1	<1
Ti	<0,1	<0,3	<0,3	<0,3	<0,3
V	<0,04	0,5	0,5	0,5	<0,2

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