PRODUCT CATALOGUE

Polypropylene

TIPPLEN TATREN

TWO COLOURS
ONE DIRECTION

MEMBERS OF THE MOL GROUP

Slovnaft PETROCHEMICALS

TVK

TWO COLOURS

ONE DIRECTION

Introduction

On 1st January, 2004 the Petrochemical Division of MOL Group integrating Slovnaft, a.s. and TVK Plc. was established and started its operation, leaving the two companies legally independent. From July 1st, 2006 Slovnaft Petrochemicals, s.r.o the 100% subsidiary of Slovnaft, a.s. is the successor of Slovnaft, a.s., continuing with production and sales of petrochemical products.

The strategic target of the group is to take the leading market position of its region due to the efficient operation of the Division. To achieve this target the production and sales activity of TVK Plc. and Slovnaft Petrochemicals, s.r.o. were harmonized, increasing supply optimalization and improving product-portfolio. Thus, considerable synergy and efficiency-improvement can be reached.

With the completion of process-optimalization the product-range of both TVK Plc. and Slovnaft Petrochemicals, s.r.o. have been streamlined to provide the competitive edge for our customers on their markets.

TIPPLEN is the registered trademark of TVK Plc. and **TATREN is** the registered trademark of Slovnaft Petrochemicals, s.r.o. Our product portfolio includes isotactic homopolymers, impact copolymers and random copolymers.

POLYPROPYLENE
general information

Polypropylene is a colourless and odourless thermoplastic polymer, translucent in the natural state, and can be pigmented in a number of colours and shades.

All types of TIPPLEN and TATREN grades are first of all characterized by high polymer purity and consistent quality. This is due to the highly sophisticated production process, in which Ziegler-Natta catalysts are used.

The most important properties of the polypropylene grades are the following:

- Low density,
- High hardness, abrasion resistance and rigidity,
- Good heat resistance (up to 100 °C if not subjected to mechanical stresses),
- Versatile, easy processability,
- Outstanding resistance to several chemicals,
- Good impact strength,
- Low water absorption and water-vapour permeability.

These properties, which vary according to certain parameters (melt flow rate, etc.), differ between homopolymers and copolymers. The essential difference between copolymers and homopolymers is that copolymers have a good impact strength, even at low temperatures.

Polypropylene has very good mechanical properties which result from regular structure and molecular weight distribution.

Polypropylene is a good insulator with very low dielectric constant and low dissipation factor. Dielectric strength depends on the temperature and the wall thickness of an item. Dielectric strength of thin wall items is very high.

Chemical resistance of polypropylene is excellent. Diluted and concentrated mineral acids and bases, polar solvents, high-molecular aliphatic compounds and inorganic salts and their solutions practically have no affect on polypropylene. This property is preserved even at high temperatures. However, it is swollen by low-molecular aliphatic, aromatic and chlorinated hydrocarbons. Strong oxidizing agents attack it at room temperature.

UV radiation and higher temperatures of the environment negatively affect physical and mechanical properties of polypropylene. Therefore it is necessary to protect PP products against these affects, mainly in outdoor applications.

APPLICATION

The wide range of grades and the consequent variation of their characteristics allow TVK Plc. and Slovnaft Petrochemicals, s.r.o. polypropylene to be used in highly different fields of application, which are briefly described as follows:

Pipes (rigid and flexible, pressure pipes, corrugated, etc.) and their relative fittings
Extruded and cast sheets, corrugated sheets, profiles
Extruded sheets for the thermoforming of containers
Rigid and flexible straps
Monofilaments, fibres, staple fibre, etc., slit and split film yarn, ropes and twines
Non-woven fabrics (spun bonded)
Household articles, toys
Parts for household appliances, battery cases
Articles and parts for the electrical-, automotive-, electronics- and textile industries
Injection or blow moulded containers for foodstuffs, cosmetics, toiletries detergents and pharmaceuticals
High speed injection moulded food-grade containers
Transparent cast and blown film, bioriented film
Furnishings (chairs and chair backs, table tops, etc.)

CODING SYSTEM - TATREN

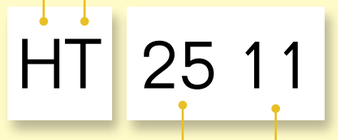
TATREN commercial grades are designated by two letters and two groups of digits.

The first letter represents the structure of the material

H = Homopolymer
I = Impact copolymer
TPO = Thermoplastic Olefin

The second letter represents typical application

F = Film
G = General purpose
M = Moulding
T = Textile



The first group of numbers represents the MFR.

The second group of numbers represents internal code.

CODING SYSTEM - TIPPLEN

TIPPLEN standard grades are coded using a system of a letter, three or four digits and one/two letters.

The first letter denotes the chemical nature of the polymer:

H = Homopolymer
K = Impact copolymer
R = Random copolymer

The melt flow index range of the polymer is indicated by **the first digit** in three-digit numbers **and by the first two-digits** in four-digit numbers.

STABILISATION PACKAGE
The stabiliser and modifier systems are indicated by **the last two numerals** of a three or four digit number.
It is an internal code only.

The last letters indicate the specific properties of the polymer.

POSSIBLE SPECIFIC PROPERTIES
A = antistatic
F, FH = film or fibre grade
U = medium UV resistance

Grade/ Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Strength at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.46 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	°C	R scale	-	-	-
Test methods	ISO 1133	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/1A	ISO 75-1,2	ISO 2039/2	-	-	-
H 890	0.3	1550	1450	34.5	12.5	13	109	89	good mechanical properties, excellent long-term heat stability	SA	extrusion, pipes, thick sheets
H 781 F	0.7	1600	1400	34.5	11.5	10	104	93	excellent processability, balanced mechanical properties	SA	extrusion, blow moulding, sheets
H 681 F	1.7	1650	1500	34	11	6	98	94	good mechanical properties, excellent processability	SA	extrusion, sheets for thermoforming, blow bottles
H 659 F	1.7	1850	1850	40	8	5.5	110	100	excellent optical properties, outstanding stiffness	NA	extrusion, sheets for thermoforming, blow bottles
H 649 FH	2.5	1700	1600	34.5	10.5	5	97	96	bimodal, for high-speed production, metallisation grades, excellent optical properties	-	biaxially oriented film
H 650 F	3	1700	1600	35	10	5	96	96	bimodal, for high-speed production, metallisation grades, excellent optical properties	-	biaxially oriented film
H 543 F	4	1700	1600	35	10.5	5	98	98	low water carry-over	-	extrusion, weaving tapes, split film yarns
H 483 F	6.5	1700	1600	34.5	10	4	94	98	good mechanical properties	SA	monofilaments, split film yarns
H 388 F	9	1500	1400	33	11	3.5	95	96	controlled rheology, high transparency and gloss	AB, SA	cast and blown film
H 284 F	18	1350	1250	31	11.5	3	89	94	controlled rheology, good adhesion at coating	SA	injection moulding, fibre, extrusion coating
H 145 F	25	1800	1700	36.5	10	3	109	102	high gas-fading resistance	SA	low denier staple fibre, BCF and CF multifilaments
H 917 A	35	1850	1750	36.5	9.5	3	113	102	controlled rheology, outstanding processability for shorter cycle times	AS, NA	thin wall injection moulding, DVD shells, household and camping articles
H 949 A	45	1900	1800	37.5	9.5	2.5	118	102	controlled rheology, outstanding processability for shorter cycle times	AS, NA	thin wall injection moulding, DVD shells, household and camping articles
H 916 A	55	1850	1750	36.5	9.5	2.5	110	102	controlled rheology, outstanding processability for shorter cycle times	AS, NA	thin wall injection moulding, DVD shells, household and camping articles

Additives:
SA slip agent
AB antiblocking agent
NA nucleating agent
AS antistatic agent

Note: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

Grade/ Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Strength at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.46 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	g/10 min	MPa	MPa	MPa	%	kJ/m²	°C	R scale	-	-	-
Test methods	ISO 1133	ISO 178	ISO 527-1.2	ISO 527-1.2	ISO 527-1.2	ISO 180/1A	ISO 75-1.2	ISO 2039/2	-	-	-
HT 3 06	3	1750	1900	36.5	9	4.5	106	102	low water carry over	-	high tenacity raffia, monofilaments, marine ropes, excellent for carpet backing, extrusion, injection moulding
HF 3 22	3	1500	1600	33	11	4.5	98	97	high speed BOPP lines, excellent optical properties	-	monolayer and co-extruded BOPP film, tobacco shrink film, metallised and pearlized BOPP film
HG 10 07	10	1650	1750	35.5	9	3	90	102	good colour stability, superior spinning characteristics, good optics	-	staple fibres, cast film, core layer at co-extrusion, injection moulding of sanitary equipments, caps, closures, small technical items
HT 25 11	25	1300	1450	31.5	10	2.5	86	100	controlled rheology, low smoke	-	spun bond, extrusion coating of PP fabrics, injection moulding
HM 35 45	35	1850	2050	38	8	2.5	120	105	controlled rheology, enhanced stiffness	NA, AS	thin wall injection moulding of bowls, buckets, caps, containers, lids and boxes for food packaging, media boxes
HM 50 46	50	1800	1950	37	9	2.8	113	105	controlled rheology, enhanced stiffness and good dimensional stability	NA, AS	thin wall containers, household articles, buckets, caps and closures, lids and trays, garden furniture, boxes for food packaging

Additives: NA nucleating agent; AS antistatic agent

Note: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

Grade/ Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Strength at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	HDT 0.46 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	**g/10 min**	**MPa**	**MPa**	**MPa**	**%**	**kJ/m²**	**°C**	**R scale**	**-**	**-**	
Test methods	ISO 1133	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/1A	ISO 75-1,2	ISO 2039/2	-	-	
R 789	0.55	900	850	27	12	30	80	55	excellent processability, outstanding long-term heat stability, expandable	-	automotive components, foamed sheets
R 659	2	1150	1050	29	12.5	24	88	78	excellent clarity and gloss	CA	extrusion, blow moulded bottles, injection stretch blow moulding
R 450 F	6.5	950	900	25	12.5	5.5	77	75	excellent transparency, gloss and very good heat weldability	AB	cast and blown film for foodstuffs, stationery clothes
R 351 F	8.5	900	850	24.5	13	5	74	73	excellent transparency, gloss and very good heat weldability	SA, AB	cast and blown film for foodstuffs, stationery clothes
R 359	12	1100	1050	29	13	6	88	81	very good transparency and excellent gloss	CA	injection moulding for packaging cosmetics, herbs, household articles
R 959 A	45	1050	950	27.5	13	5	84	78	controlled rheology very good transparency and excellent gloss, good resistance to warping	AS, CA	thin wall injection moulding for packaging cosmetics, sweets, household articles

Additives:
SA slip agent
CA clarifying agent
AB antiblocking agent
AS antistatic agent

Note: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

Grade/ Parameter	Melt Mass-Flow Rate (MFR) 230 °C/2.16 kg	Flexural Modulus *	Modulus of Elasticity in Tension *	Tensile Strength at Yield *	Tensile Strain at Yield *	Notched Izod Impact at 23 °C *	Notched Izod Impact at -20 °C *	HDT 0.46 MPa *	Hardness Rockwell *	Special features	Special additives	Application
Units	**g/10 min**	**MPa**	**MPa**	**MPa**	**%**	**kJ/m²**	**kJ/m²**	**°C**	**R scale**	-	-	-
Test methods	ISO 1133	ISO 178	ISO 527-1,2	ISO 527-1,2	ISO 527-1,2	ISO 180/1A	ISO 180/1A	ISO 75-1,2	ISO 2039/2	-	-	-
K 899	0.35	1200	1100	27	14	54	7	90	60	excellent heat and detergent resistance very high impact strength	SA	extrusion, pipes, sheets, blow moulding
K 793	0.7	1300	1100	26	12	55	4.5	88	60	very high impact strength	SA	corrugated cardboard, corrugated pipes, extrusion, sheets, blow moulding
K 693	2	1300	1150	25.5	9	20	4.5	88	68	high impact strength and stiffness	SA	corrugated cardboard, corrugated pipes, extrusion, sheets, blow moulding injection moulding
K 691	1.3	1400	1300	27.5	9.5	53	5.5	100	75	high impact strength and stiffness	SA, NA	corrugated cardboard
K 597	4	1050	950	22	9	48	7	77	59	outstanding high impact strength	SA	injection moulding, automotive components, battery cases
K 499	6.5	1300	1150	25.5	8.5	10	4.5	83	77	excellent resistance to heat and chemical	SA	injection moulding, automotive components, battery cases, crates, boxes, dowels
K 392	12	1300	1150	25	7.5	9	4.5	83	77	good impact strength and stiffness	SA	injection moulding, household articles, pails, toys
K 395 A	12	1450	1400	26.5	6	9.5	4.5	106	85	high stiffness	AS, NA	injection moulding, household articles, pails, boxes, garden furniture
K 397	12	1150	1000	22	8	13	5	80	62	high impact strength	SA	injection moulding, household articles, pails, toys
K 295 A	20	1600	1550	28.5	5.5	7	4	115	88	high stiffness	AS, NA	thin wall injection moulding, household articles
K 199	30	1450	1400	27.5	5	6	4	105	90	good flow, low C-emission and odour	NA	thin wall injection moulding, automotive components
K 948	45	1300	1250	24.5	6	8	4	97	80	controlled rheology, good flow and impact strength	NA	High-speed injection moulding, thin-walled packaging containers, pails, covers, garden furniture
K 1048	70	1300	1200	23.5	6	7	4	98	78	controlled rheology, very good flow, excellent processability	AS, NA	High-speed injection moulding, thin-walled and big size packaging containers, pails, covers, garden furniture
TPO 12 76	12	900	1100	19	12	50	34	86	40	controlled rheology, extra high impact strength, good impact/stiffness balance	NA	compounding, automotive applications and bumpers, injection moulding
TPO 20 77	20	950	1150	20	12	45	30	81	49	controlled rheology, extra high impact strength, good impact/stiffness balance	NA	compounding, automotive applications and bumpers, injection moulding
IM 6 56	6.5	1450	1550	27	7	10	4	88	88	excellent long-term heat stability, high stiffness and good impact resistance	AS	injection moulding of parts for household appliances, auto battery cases and technical items where long term heat resistance is required
IM 12 59	12	1550	1650	26.5	5	10	5	108	88	high stiffness, good impact resistance	NA, MR	injection moulding of rigid packaging, storage and transport boxes, household articles and technical items
IM 22 63	22	1500	1650	26	5	9	4.5	107	88	controlled rheology, high stiffness, good impact resistance	NA, MR	injection moulding of rigid packaging, household articles, garden furniture and technical items
IM 25 75	25	1250	1350	22	6.5	40	6	94	69	controlled rheology, excellent impact resistance and good stiffness	NA, AS	heavy duty injection moulded products, medical and transport containers, crates, boxes, technical items, compounding
IM 45 74	45	1500	1650	26	5	8	4.5	105	88	controlled rheology, high stiffness and good impact resistance, good flow	NA, AS, MR	high speed thin wall injection moulding of rigid packaging, household articles, garden furniture and technical items
IM 65 73	65	1500	1650	26	5	7	4	107	87	controlled rheology, high stiffness, good impact resistance, good flow	NA, AS,	high speed thin wall injection moulding of rigid packaging, household articles, garden furniture and technical items

IMPACT COPOLYMERS

Additives:
SA slip agent
NA nucleating agent
AS antistatic agent
MR mould release agent

Note: * Values have been measured on standard injected moulded specimens prepared in accordance with ISO 1873-2.

PRODUCT SELECTION CRITERIA BASED ON THE TYPE OF POLYPROPYLENE

Selection criteria	Homopolymer	Random copolymer	Impact copolymer and TPO
Stiffness	first choice	not recommended	second choice
Toughness >0 °C	second choice	second choice	first choice
<0 °C	not recommended	second choice	first choice
Transparency	second choice	first choice	not recommended

EFFECT OF NUCLEATION ON TECHNICAL PROPERTIES

Technical properties	Trend
Stiffness	+
Impact resistance	=
Transparency*	+
Cycle time	+
Shrinkage (total)	-
Processability	+

+ improvement = no change - decline

* Nucleating agent slightly improves transparency of homopolymers and random copolymers. Much better optical properties using special type of nucleator –clarifying agent - are achieved. Nucleated impact copolymers are never transparent, they are opaque.

SUPPLEMENTARY INFORMATION

MISCELLANEOUS PROPERTIES OF POLYPROPYLENE RESINS*

Physical	Density (ISO 1183)	0.9 g/cm^3
	Bulk Density (ISO 60)	0.46-0.58 g/cm^3
	Melting point (ISO 11 357-3)	
	Homopolymer	156-165 °C
	Impact copolymer	115 and 158-165 °C
	Random copolymer	133-150 °C
	Water absorption (ASTM D 570)	<0.03%
	Mould Shrinkage (ISO 294-4)	1.1-2.5%
Thermal	Thermal Conductivity (ASTM C 518)	
	solid	0.23 W/(m·K)
	melt	0.16 W/(m·K)
	Coefficient of Linear Expansion	
	at 20 °C	1.1x10^{-4} K^{-1}
	at 80 °C	1.7x10^{-4} K^{-1}
	Specific heat (ASTM D 2766)	
	at 23 °C	1.68 J/(g·K)
	at 100 °C	2.10 J/(g·K)
Electrical	Dielectric Constant (DIN 53 483)	2.27 (at 50 Hz)
	Dielectric Strength (DIN 53 481)	500 kV/cm
	Volume Resistivity (DIN 53 482)	>10^{17} Ω·cm
	Surface Resistivity (DIN 53 482)	10^{14} Ω
	Dissipation Factor (DIN 53 483)	<4·10^{-4} (at 50 Hz)

*Properties of individual product shipments may vary slightly from published properties. This information is provided upon the condition that users should make their own test to determine the safety and suitability of each product for their own purposes.

Storage and Handling

Pellets are packed in 25 kg PE-LD bags and transported on shrink-wrapped pallets at eligible load of polymer 1250 or 1375 kg. Heat treated pallets are available as well.Transportation in a road silo or rail silo is also available. For more detailed information please contact Slovnaft Petrochemicals and TVK sales representative.

Since polypropylene is a combustible substance, the fire safety rules applicable for combustible materials in warehouses and store rooms should be observed.

If polymer is stored in conditions of high humidity and fluctuating temperatures, then atmospheric moisture can condense inside the packing. If it happened, it is recommended the pellets to be dried before use. During the storage polypropylene should not be exposed to UV radiation. Producer does not take responsibility for any damages caused by adverse storage.

REACH Statement

Polymers are exempt of REACH registration. However their raw materials which means monomers, catalysts and most additives have been pre-registered. SPC/TVK is committed to fully respect this new legislation and will only use REACH compliant raw materials. At this point in time SPC/TVK polypropylene TATREN/TIPPLEN do not contain any substances specifically identified as SVHC at levels greater than 0.1%.

Application for foods

Most Tipplen and Tatren grades satisfy the regulations applied by the European countries (EEC) and the requirements specified by the Food and Drug Administration (FDA), USA for food packaging materials. Because several European countries apply restrictive regulations for the allowed migration values of additives in packaging material in contact with food, it is recommended that customers contact TVK or Slovnaft Petrochemicals for some special information or product licenses for food industry.

Safety

Under normal circumstances polypropylene is not regarded as hazardous material when in contact with the skin or when inhaled. However, any contact with the molten polymer or the inhalation of the released gases should be avoided in processing. It is recommended to install exhaust units over processing machines and to secure good ventilation of the place.

For further information see Material Safety Data Sheet.

Recycling

Polypropylene resins are suitable for recycling using modern recycling methods.

In-house production waste should be kept clean to facilitate direct recycling.

Disclaimer

The information provided in this publication has been compiled to the best of our present knowledge. However, in view of the various applications of polypropylene resins and the equipment used, the processing conditions may differ.

The recommendations and data herein are to be construed as informatory only and do not relieve users from carrying out their own tests and experiments prior to processing in order to check suitability for a specific use. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed. Our products are under continuous development, therefore we reserve the right to change the information presented in this brochure at our own discretion.

The REACH statement herein does not constitue legal advice. The REACH statement is provided for informational purpose only.

TWO COLOURS

ONE DIRECTION

Sales offices:

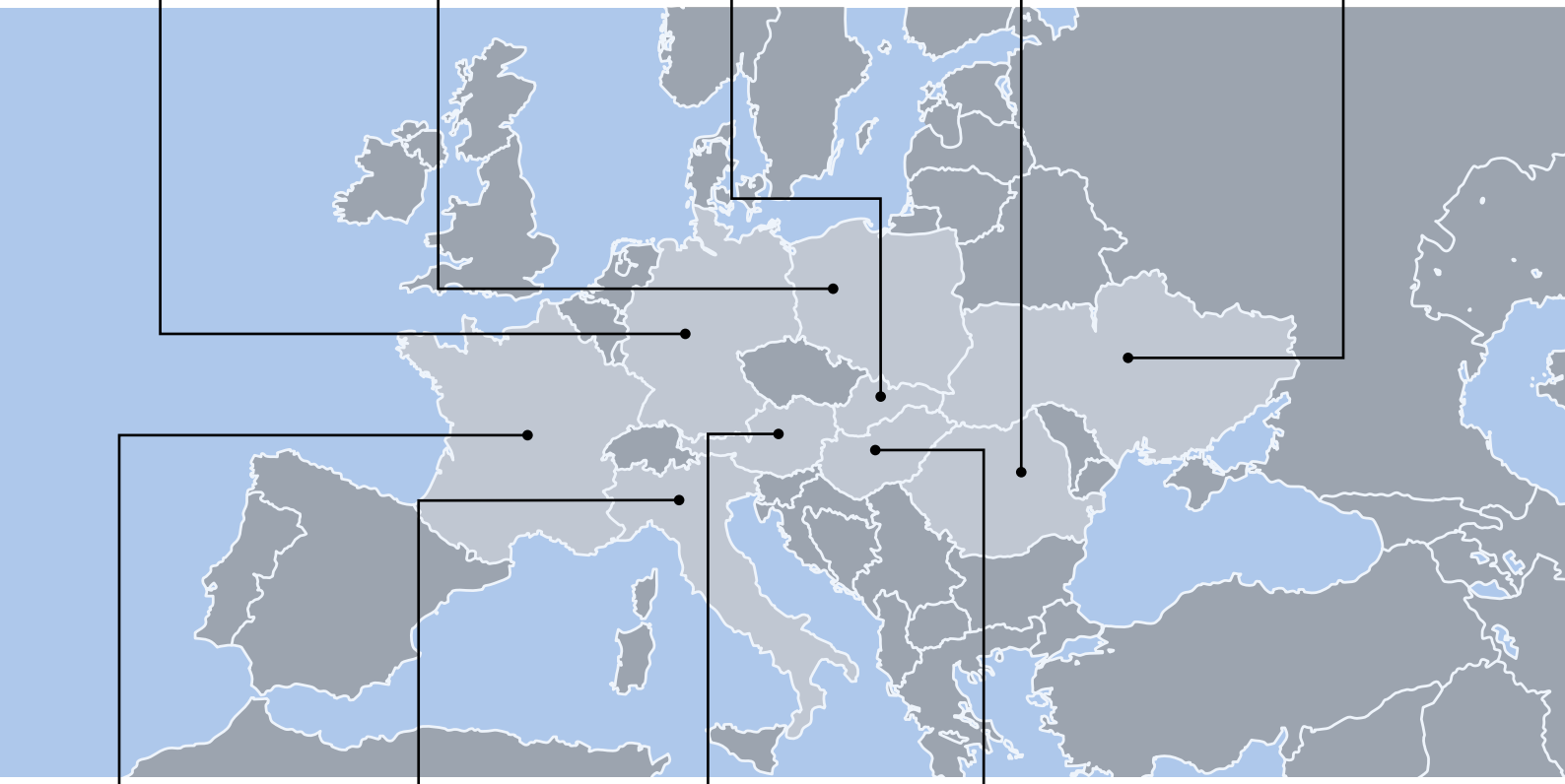
Germany
TVK Interchemol GmbH
Felnerstrasse 5
D-60322 Frankfurt am Main
phone: +49 69 154 04 12
fax: + 49 69 154 04 41
gaboragoston@tvkic.de

Poland
TVK Polska Sp. z o.o.
ul. Wąwozowa 23/12
PL 02-796 Warszawa
Poland
phone: +48 22 545 70 70
fax: +48 22 545 70 60
tvkpolska@tvkpolska.pl
www.tvkpolska.pl

Slovak Republic
Slovnaft Petrochemicals, s.r.o.
Vlčie hrdlo 4846
824 12 Bratislava
Slovak Republic
phone: +421 2 58 59 7469
fax: +421 2 58 59 7381
info@slovnaft.sk
www.slovnaft.sk

Romania
MOL Romania PP SRL
Str. Daniel Danielopolu nr. 4-6
ET.2, Sector 1 Cod 014134
Bucuresti, Romania
phone: +40 21 204 85 00
+40 21 204 85 02
fax: +40 21 232 1059
ematei@molromania.ro
petchem@molromania.ro

Ukraine
TVK Ukraine
04128 Kiev
ul. Tupoleva, 19, office 303
phone: +380 44 374 00 80
fax: +380 44 374 00 90
office@tvkukraine.eu



France
TVK France
182 Avenue Charles de Gaulle
F-92200 Neuilly sur Seine
phone: +33 14 745 63 60
fax: +33 14 745 45 10
kacsandi@free.fr
tvk.france@orange.fr

Italy
TVK Italia Srl.
Via P. Teulié 1
I-20136 Milano
phone: +39 02 58 30 55 23
fax: +39 02 58 30 34 92
tvkitaly@energy.it

Austria
MOL-Austria Handels GmbH
Gartenbaupromenade 2/6
A-1010 Wien
phone: +43 1 515 991 120
+43 1 515 991 121
fax: +43 1 513 37 55 1120
+43 1 513 37 55 1121
JHauk@MOL.hu

Hungary
TVK Nyrt.
H-3581 Tiszaújváros
P.O.B. 20
phone: +36 49 52 13 55
fax: +36 49 52 24 10
polymersales@tvk.hu
www.tvk.hu

Other European Countries
H-3581 Tiszaújváros
P.O.B. 20.
phone: +36 49 522 118
fax: +36 49 522 410
plokai@tvk.hu

Certificates

Slovnaft Petrochemicals

TVK

Slovnaft PETROCHEMICALS

TVK

Published in April 2009