

DOUBLE WALL POLYETHYLENE CORRUGATED PIPES

# PECOR OPTIMA

QUALITY ASSURANCE







## PECOR OPTIMA® pipes produced by ViaCon Sp. z o.o. are perfect for use in engineered structures:

- roads and railway culverts
- ecological passages (for animals)
- forestry culverts
- relining of existing old culverts
- ventilating system
- agro-ventilation



## Application

PECOR OPTIMA® - exceptional, helically corrugated double wall pipes with smooth inside are used for building culverts and outdoor sewage pipelines system. The unique structure of PECOR OPTIMA® pipes is a result of Scandinavian long-term experience in culvert & sewage technology.

According to the latest PPI (Plastic Pipes Institute) corrugated pipes produced of polyethylene can be designed on the assumption of 100 years lifetime.

PECOR OPTIMA® system is widely used in civil engineering. Due to the fast assembly and very good strength and hydraulic parameters, the system has

received wide recognition among designers and contractors. Unique spiral structural wall allows to get the optimal stress distribution on the whole pipe length and ensure the proper ring stiffness on each section. Smooth inside wall of PECOR OPTIMA® pipes allows to achieve good hydraulic parameters.

PECOR OPTIMA® pipes can be used as curved in plane and profile.

Broad range of fittings (elbows, T-pipes, reductions) make up complete system.

## Advantages of using system

### PECOR OPTIMA®

- no needs to use heavy equipment for installation
- versatile system due to wide range of fittings
- fast and easy assembly (light-weighted)
- low transportation costs
- optimal strength and hydraulic parameters
- no corrosion concern

## Material

Raw material which is used for the production of PECOR OPTIMA® pipes is high density polyethylene (HDPE). Mechanical and physical characteristic properties are provided below:

- density: 0,942 [g/cm<sup>3</sup>]
- Young modulus:
  - $E_{\text{short-term}} = 600 \div 1000$  [MPa]
  - $E_{\text{long-term}} = 150 \div 300$  [MPa]
- ultimate elongation: > 800 [%]
- melt flow index MFI: 0,15 ÷ 0,50 [g/10min] for loading 2,16 kg
- coefficient of linear thermal expansion:
  - $\alpha = (1,5 \div 2,0) \times 10^{-4}$  [1/°C]
- working temperature range: -30 ÷ +75 [°C]

There is a mixture of polyethylene and black coloring dye stabilized on UV radiation used for PECOR OPTIMA® production.



## Technical approvals

PECOR OPTIMA® pipes have the following documents:

- Technical Approval issued by Polish Road and Bridge Research No KOT- 2017/0024 issue 1 [2]
- positive opinion from Polish Central Mining Institute (GIG) for use of pipes on subsidence areas [3]

## Construction of PECOR OPTIMA® pipe

PECOR OPTIMA® pipes are produced with double wall, smooth inside and corrugated outside (Fig. 1).

The corrugation is stiff and can interact with surrounded soil. The corrugation size and the distance between corrugation depend on the diameter of the pipe (the bigger dimension, the larger corrugation).

Corrugation detail of PECOR OPTIMA® pipes is shown in Fig. 2. The dimensions and the tolerances are presented in table 1.

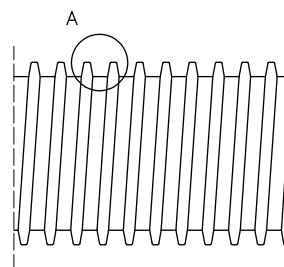


Fig. 1. View of PECOR OPTIMA®

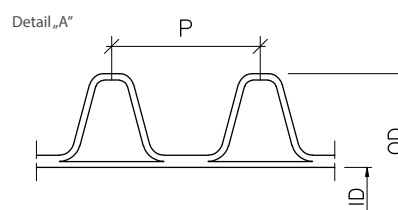


Fig. 2. Corrugation detail of PECOR OPTIMA®



# PECOR OPTIMA® DOUBLE WALL POLYETHYLENE CORRUGATED PIPES

Item	Nominal diameter DN [mm]	Outside diameter OD [mm]	Inside diameter ID [mm]	Area [m <sup>2</sup> ]	Period of corrugation P [mm]
1	300	357±2%	300±2%	0,07	55,5
2	400	477±2%	400±2%	0,13	74,0
3	500	593±2%	500±2%	0,20	92,0
4	600	724±2%	600±2%	0,28	108,0
5	700	824±2%	700±2%	0,38	108,0
6	800	970±2%	800±2%	0,50	140,0
7	900	1070±2%	900±2%	0,64	140,5
8	1000	1175±2%	1000±2%	0,79	142,0
9	1200	1375±2%	1200±2%	1,13	142,0
10	1400	1570±2%	1400±2%	1,54	142,0

Tab. 1. Nominal diameter (DN) of PECOR OPTIMA® pipes refer to inside diameters (ID)

## Strength

Standard PECOR OPTIMA® pipes are produced in the following classes of ring stiffness:

- SN 4 (4 kPa) - pipes 1400 mm
- SN 6 (6 kPa) - pipes from 300 mm to 1400 mm
- SN 8 (8 kPa) - pipes from 300 mm to 1200 mm

## Standards length of PECOR OPTIMA® pipes

The standard lengths of PECOR OPTIMA® pipes are L=6 m, 7 m, 8 m (refer to SN 8) and L = 6 m (refer to SN 4 and SN 6).

The production process allows to make pipes with 12 m length (refer to SN 8).

## Connection of PECOR OPTIMA® pipe

PECOR OPTIMA® pipes are joined with coupling bands. They are available as one-piece band (Fig.3a), and in two-pieces band (Fig.3b).

PECOR OPTIMA® pipes including coupling bands make up the sand tight system.

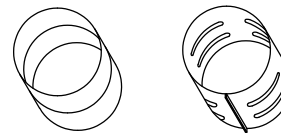


Fig. 3a

Fig. 3b

Fig. 3 Scheme of PECOR OPTIMA® connection

## PECOR OPTIMA® culvert pipes

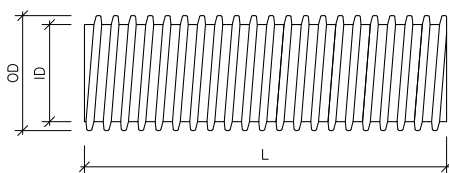


Fig. 4. PECOR OPTIMA® culvert pipe

Item	Symbol	Diameter [mm]		Nominal length [m]
		ID	OD	L
1	PECOR OPTIMA 300	300	357	Standard lengths: 6, 7, 8 m (SN 8) 6 m (SN 4 and SN 6) Length of pipe (max. up to 12 m is available - SN 8)
2	PECOR OPTIMA 400	400	477	
3	PECOR OPTIMA 500	500	593	
4	PECOR OPTIMA 600	600	724	
5	PECOR OPTIMA 700	700	824	
6	PECOR OPTIMA 800	800	970	
7	PECOR OPTIMA 900	900	1070	
8	PECOR OPTIMA 1000	1000	1175	
9	PECOR OPTIMA 1200	1200	1375	
10	PECOR OPTIMA 1400	1400	1570	

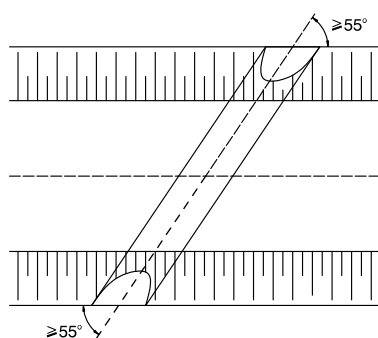


Fig. 5. Skew angle of the pipe

## Pipe end finishing

Using PECOR OPTIMA® pipes enables an accurate adjustment of both ends slope and required angle.

Bevel cut can be done on one or both sides with full bevel or step bevel.

It is recommended to use vertical step of 1/3 the height of the pipe.

### There are several possibilities of end finishing:

#### Vertical end:

- reinforced concrete head wall
- head wall made of gabions

#### Beveled end:

- slope paved with concrete or stone blocks placed on sand-cement
- slope paved with perforated concrete panels
- slope paved with stone rip rap
- reinforced concrete collar

It is recommended to pave bottom of the river. Concrete blocks, stone, gabions or other available material can be used.

Skewed (90°) end can be made for both vertical and beveled end. Minimum allowable skew angle is 55° (Fig. 5).

In special cases it is necessary to make additional reinforcement in the skewed area.

Please contact ViaCon Technical Department to get more information.

## Fittings, coupling bands for PECOR OPTIMA® pipes

Complement system consists of:

- coupling bands ( full ring, one-piece band, two-pieces band)
- elbow ( 30°, 45°, 60°, 75°, 90°)
- T-pipes (45°, 90°)

Fittings with other angles are available.



## Hydraulic parameters of PECOR OPTIMA® pipes

Diameters of pipe should be determined on the basis of hydraulic calculation, depending on expected volume of flow. Figure 6 shows the reference water flow  $Q_m$  for

PECOR OPTIMA® pipes with water flow at 75% height. Water-flow regulations may differ slightly depending on national standards.

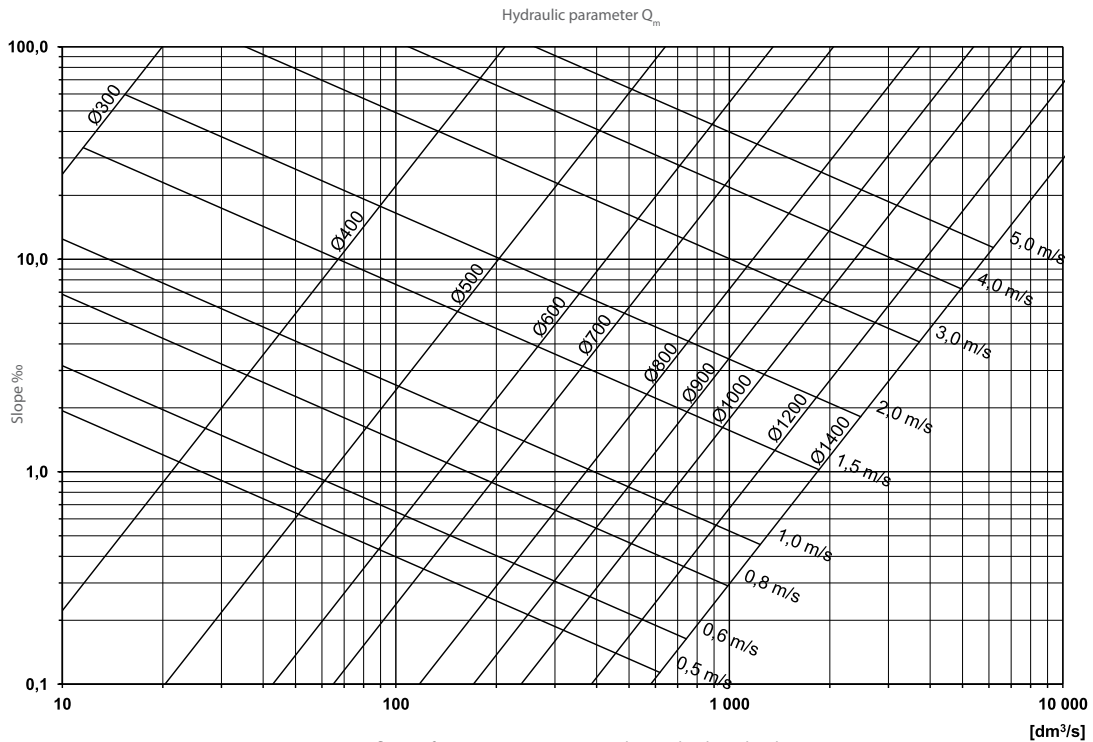


Fig. 6. Water flow  $Q_m$  for PECOR OPTIMA® pipes with water level 75% height

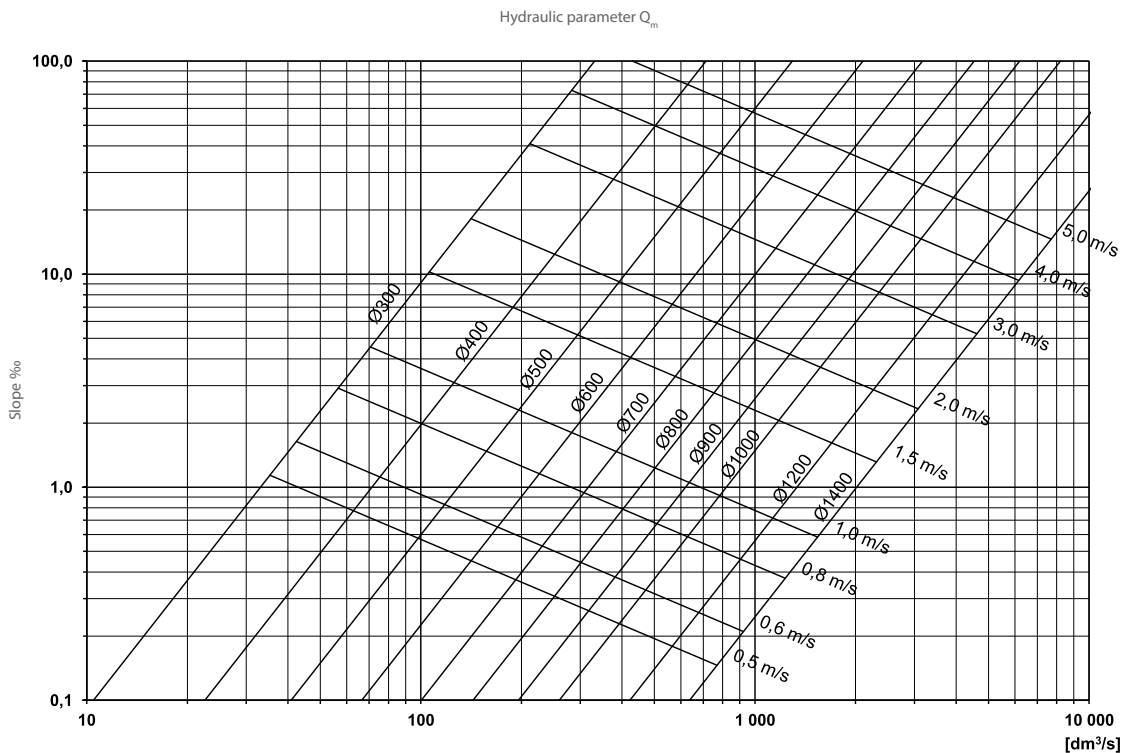


Fig. 7. Water flow  $Q_m$  for PECOR OPTIMA® pipes with water level at 100% height

## PECOR OPTIMA® M sewage manholes – application

Manholes are used for:

- non-pressure sewage system
- roads dewatering
- parking places dewatering

**PECOR OPTIMA® M** manholes are produced in three types:

- three way pipe
- sedimentation tanks
- eccentric

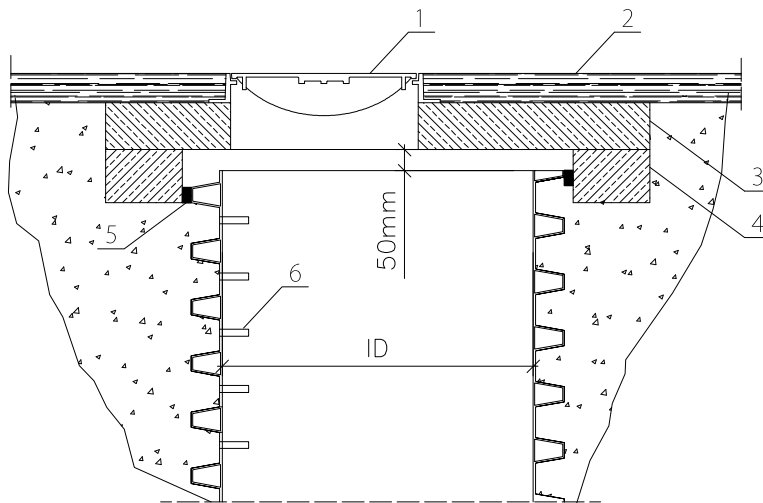
Manhole PECOR OPTIMA® M in dimensions ID=1000 mm, 1200 mm, 1400 mm are equipped with steps.

Sewage manholes PECOR OPTIMA® M are adopted to connect with cast iron or concrete cover in proper class. Figure 8 shows an example of PECOR OPTIMA® M manhole cover.

There are stud couplings on the bottom part of manhole made from PECOR OPTIMA® pipes or connector pipes made of HDPE adopted to connect sewage pipes.

The bottom of the manhole PECOR OPTIMA® M is made of HDPE plate.

The whole stub pipes & bottom are connected with main manhole body pipe by welding.



- 1 – manhole cover in proper class: A15÷D400
- 2 – surface
- 3 – concrete slab
- 4 – cover ring
- 5 – sealing ( space between main pipe and reinforced plate)
- 6 – steps

Fig. 8. PECOR OPTIMA® M - manhole cover

## Cover depth for PECOR OPTIMA® and Pecor Quattro

### Definition of the cover depth for road structures

Cover depth can be described as a vertical distance between the top of the culvert and the road grade-line, including the road pavement.

### Definition of the cover depth for railway structures

Cover depth for culvert under railway can be described as a vertical distance between the top of the culvert and the bottom of the railway sleeper, including the construction layers of the railroad.

Tab. 1. Cover depth

Type of structure	Min. cover depth
cover depth for road structures	$H_{min} = \begin{cases} DN/ID \ 200 \div 500 & - 0,3 \ [m] \\ DN/ID \ 600 \div 1000 & - 0,5 \ [m] \\ DN/ID > 1000 & - \frac{1}{2} \times DN/ID \ [m] \end{cases}$
cover depth for railway structures (for live load $ak=+2$ )	$*H_{min} = \begin{cases} 0,6 \ [m] \end{cases}$

\* refer to SN 8

In case of construction traffic the cover depth must be agreed with Technical Department of ViaCon company.





## Material for bedding and backfill for PECOR OPTIMA® and Pecor Quattro pipes

- gravel, sand -gravel mix, all-in aggregates and crushed stone can be used as bedding and backfill material
- aggregate grain size depends on size of corrugation profile
- aggregate size should have (0,3 m ÷ 0,5 m) 31,5 mm
- the use of cohesive soil, organic soil and soils included permafrost is not acceptable
- backfill material around the structure should be placed in un-compacted layers and then compacted:
  - un-uniformity coefficient  $C_u \geq 4$
  - curvature coefficient  $1 \leq C_c \leq 3$
  - permeability  $k_{10} > 6$  m/day
  - backfill material should be compacted to minimum 0,95 of Standard Proctor Density, but 0,98 of Standard Proctor Density - in the pipe adjacent

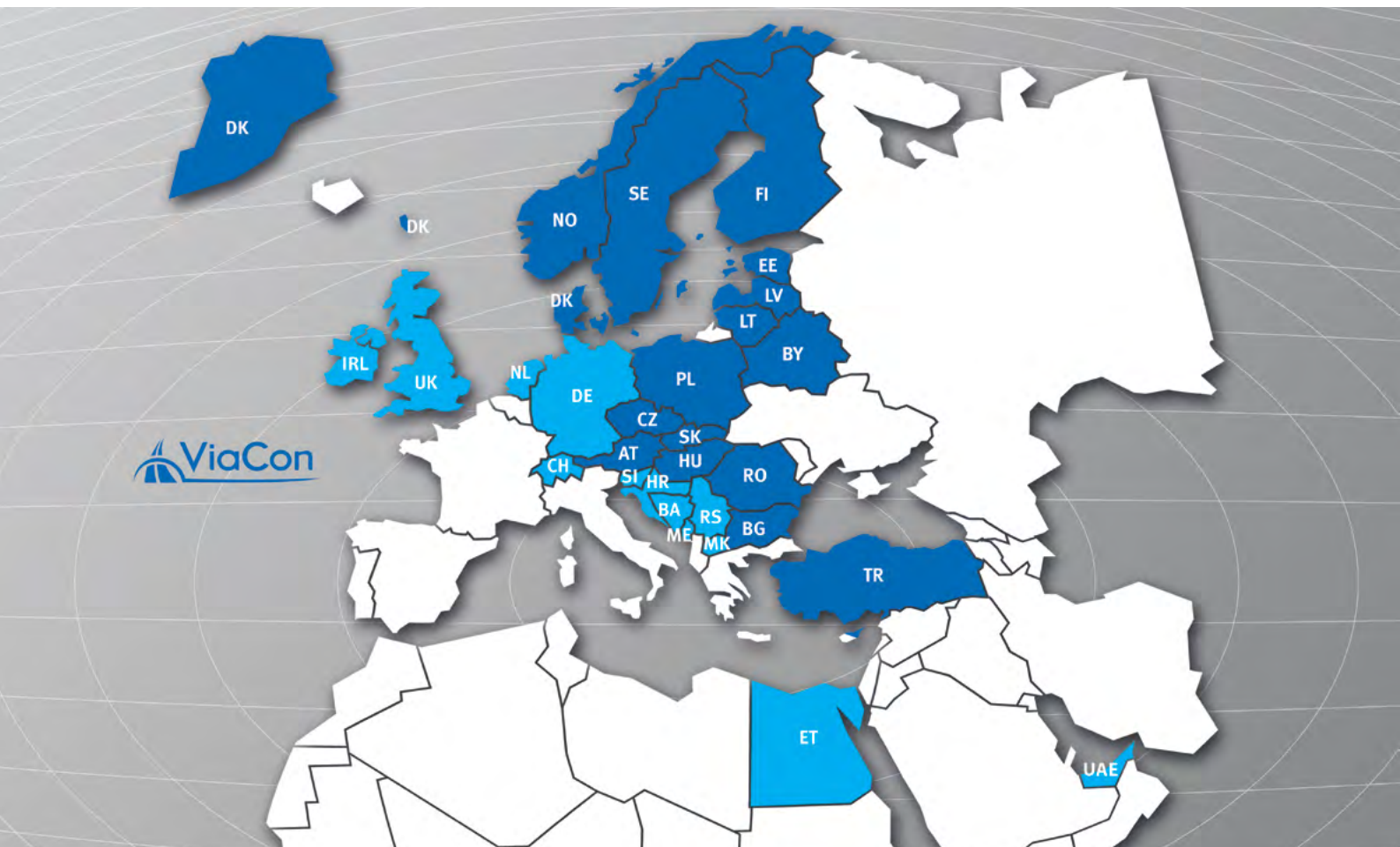
Deviation from these principles requires consultation with the Technical Department of our company.





## **Literature and standards** **for PECOR OPTIMA® and Pecor Quattro pipes**

- [1] Design and technology guidelines for flexible engineering structures made of plastics. Annex to the Ordinance No. 30 of the General Directorate for National Roads and Motorways, dated 2 November 2006. Bridge and Road Research Institute (IBDiM), Branch in Wrocław
- [2] Technical Approval issued by Polish Road and Bridge Research No KOT- 2017/0024 issue 1
- [3] Technical opinion of the Central Mining Institute (GIG): „Opinion on the conditions for use of Pecor Optima structured-walls sewerage and culvert pipes in areas affected by mining”, 2007.



**” ViaCon Sp. z o.o. is a member of ViaCon Group established in Sweden and Norway in 1986. At present, ViaCon Group operates in a 18 European countries and belongs to SAFEROAD® Group. ViaCon is currently the largest European group in the field of flexible pipes and structures. “**

All companies share Group experience to their customers worldwide.

ViaCon has been operating in the Polish market since 1997. At present, ViaCon has subsidiary companies in the Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria and Turkey.

The company owes its success to people. The people in the company, as well as those who put their trust in us

and for many years have been changing the world for better and creating a better future together with us.

People from ViaCon are well educated, loyal, professional and friendly. Many of them are young, and therefore our strength lies in the ability to combine experience with the continuous development and the desire to be better.

Our customers are not only large multinational corporations, but also small local companies. We cooperate with road and railway administration centres, universities and research institutes. We treat all collaborative organizations equally and promote good cooperation.

ViaCon was the first company to introduce a system of steel flexible pipes and structures to the Polish market. This system has strongly contributed to reducing the costs of roads and motorways and accelerated their construction.

ViaCon has a comprehensive offer for infrastructure markets. Products and solutions offered by the company are used in construction of roads and railways around the world. Systems manufactured by ViaCon are exported to over twenty five countries throughout the world. Our products are used for constructing, strengthening and reconstruction of culverts, bridges, tunnels, underpasses, as well as for assembly of temporary bridges. We also produce, design and install underground retention systems.

Corrugated steel structures manufactured by ViaCon are used also in the industrial construction sector and in the mining sector as conveyor belt protection and protection of pipes (eg heating pipes). Our product offering also includes the Pecor Quattro system manufactured from polypropylene, which is intended, inter alia, for construction of gravity sewage systems, storm-water drainage systems and sanitary sewage systems, as well as the very popular HDPE culvert pipes PECOR OPTIMA®. ViaCon designs, manufactures and installs the manufactured products, which allows us to implement tasks in a comprehensive manner.

Over the last 20 years, ViaCon has become a European leader in this field. Our production plant in Rydzyna near Leszno (Wielkopolskie Province) is the largest in Europe and one of the largest in the world.

The company cooperates closely with the state administration, suppliers, as well as scientific and research centres in Europe, the United States and Canada.

This results in a wide range of innovative solutions offered by ViaCon, including underground retention systems, advanced corrosion protection systems, and comprehensive system solutions for storm-water drainage systems and sanitary sewage systems.

ViaCon Group is a pioneer in the production of SuperCor® flexible structures in the European market. Solutions of corrugated plate structures on flexible foundations constitute another example of our innovative approach to implementation and provides cost and construction time savings.

Our company, was the first in Poland to place double-wall HDPE pipes (PECOR OPTIMA®) on the market. They are used as plastic culverts. ViaCon also produces MSE retaining walls systems under the trade names ViaWall® and ViaBlock®.

The company offers a wide range of geosynthetics, such as non-woven geotextiles, woven geotextiles, geogrids, geomembranes, and bentonite mats. Geosynthetics are polymer products characterized by high durability. Such products can be built into the subsoil to improve its mechanical and hydraulic parameters. They are widely used in hydraulic engineering, drainage, construction and forestry.

ViaCon has certified its Integrated Quality Assurance System according to ISO 9001:2008 and ISO 14001:2004, as well as OHS Management System according to the OHSAS 18001 standard. The offered products: MultiPlate MP200, HelCor® i HelCor PA, SuperCor®, and geosynthetics all bear the CE mark.

ViaCon continuously strives to introduce new ideas and technologies that could improve its production system. To this end, we develop a Lean Manufacturing culture. We implement the following elements to support this concept: 6S, Kaizen, Process standardization, TPM. In doing so, we use a number of tools, such as: 5W, Ishikawa, OEE, Mapping, PDCA and Pareto principle. The integrated knowledge management system, which functions in ViaCon, is unique in our industry.



# INNOVATIVE INFRASTRUCTURE

PECOR OPTIMA



HelCor



HelCor PA



MultiPlate MP200



SuperCor



UltraCor



Temporary and permanent  
Acrow bridges



Vowen and nonwoven geotextiles



Geogrids



Gabions



ViaWaterTank



HelCor® wells



Pecor Quattro



PECOR OPTIMA wells



ViaWall A®



ViaWall B®



ViaBlock®



ViaFence



CON/SPAN



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