TECHNICAL REPORT
- INDUSTRIAL WASTEWATER TREATMENT PLANTS
IN DORUCHÓW

OBJECT:	**Construction of a new biomechanical, industrial wastewater treatment line, with a filter thoroughly removing phosphorus, up to a value of less than 3 mgP / l without the use of chemicals, at the wastewater treatment plant in Doruchów**
INVESTOR:	**Doruchów Commune, Commune Office in Doruchów ul. Kępińska 13 63-505 Doruchów**
GENERAL CONTRACTOR:	**Zakład Projektowania I Wykonawstwa EKOLOGIA – Janusz Przybył ul. Kozienicka 26 62-800 Kalisz**

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Stamp and signature:

Table of Contents

1. Name of the technical solution.

Project name: Testing of nutrient removal technology for industrial wastewater (Doruchów) Goal: Industrial wastewater treatment with the use of innovative filters for phosphorus removal

2. Scope of the study.
The subject of the investment was the construction of a new biomechanical industrial wastewater treatment plant with a filter, thoroughly removing phosphorus, up to a value of less than 3 mgP / l without the use of chemicals, at the wastewater treatment plant in Doruchów with a capacity of Q average = 60m3 / d.

3. Location of the investment area. Construction of a new industrial wastewater treatment line as an extension of the existing wastewater treatment plant is located in Doruchów at ul. Powstańców Wielkopolskich 3, in the Ostrzeszów county, Greater Poland voivodship, plot no. 818, Doruchów precinct, Doruchów commune. The plant is located outside of the sprawl, surrounded by arable land.

4. Scope of construction works.
As part of the construction of a new biomechanical line of industrial wastewater treatment, the following objects were built, on a development area of 252.95 sq m:

- catchment point for delivered wastewater - Object No. 1
- averaging / surge tank - Object No. 2
- biological reactor - Object No. 3
- secondary sedimentation tank - Object No. 4
- dolomite reservoir tanks with a pH correction station - Object No. 5
- measuring well - Facility No. 6
- deposit storage yard - Facility No. 7
- blower station - Facility No. 8

The scope of construction also included hardening of the area, pavements and inrun slabs with an area of 702.40 sq m, as well as the construction of technological pipelines (sewage, water, sludge, air pipelines with the necessary fittings), power supply and lighting installations and C&I equipment
.

The following pictures show the phases of construction works:
Photo. No. 1. Reinforcement of the biological reactor.

Photo. No. 2. The first stage of the walls of the biological reactor

Photo No. 3. Performing internal insulation in the biological reactor.

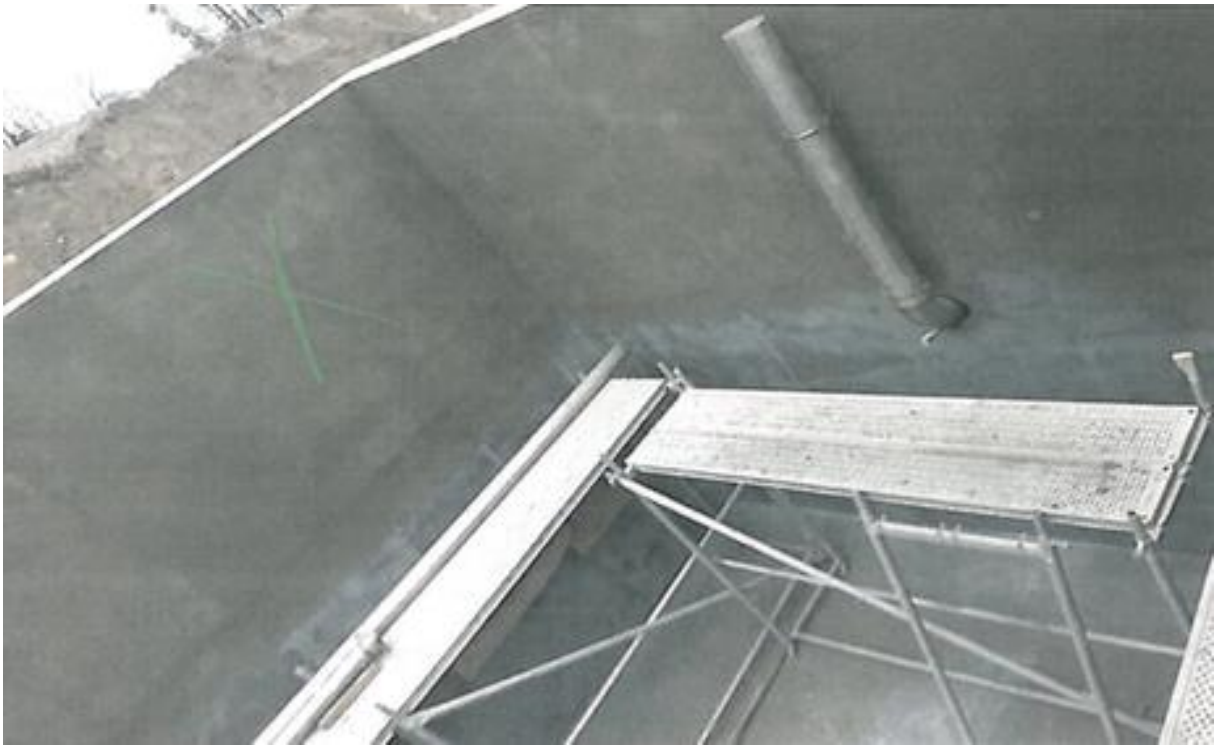


Photo No. 4. Installation of the biological reactor technology.

Photo No. 5. Leak test of the biological reactor aeration grates.

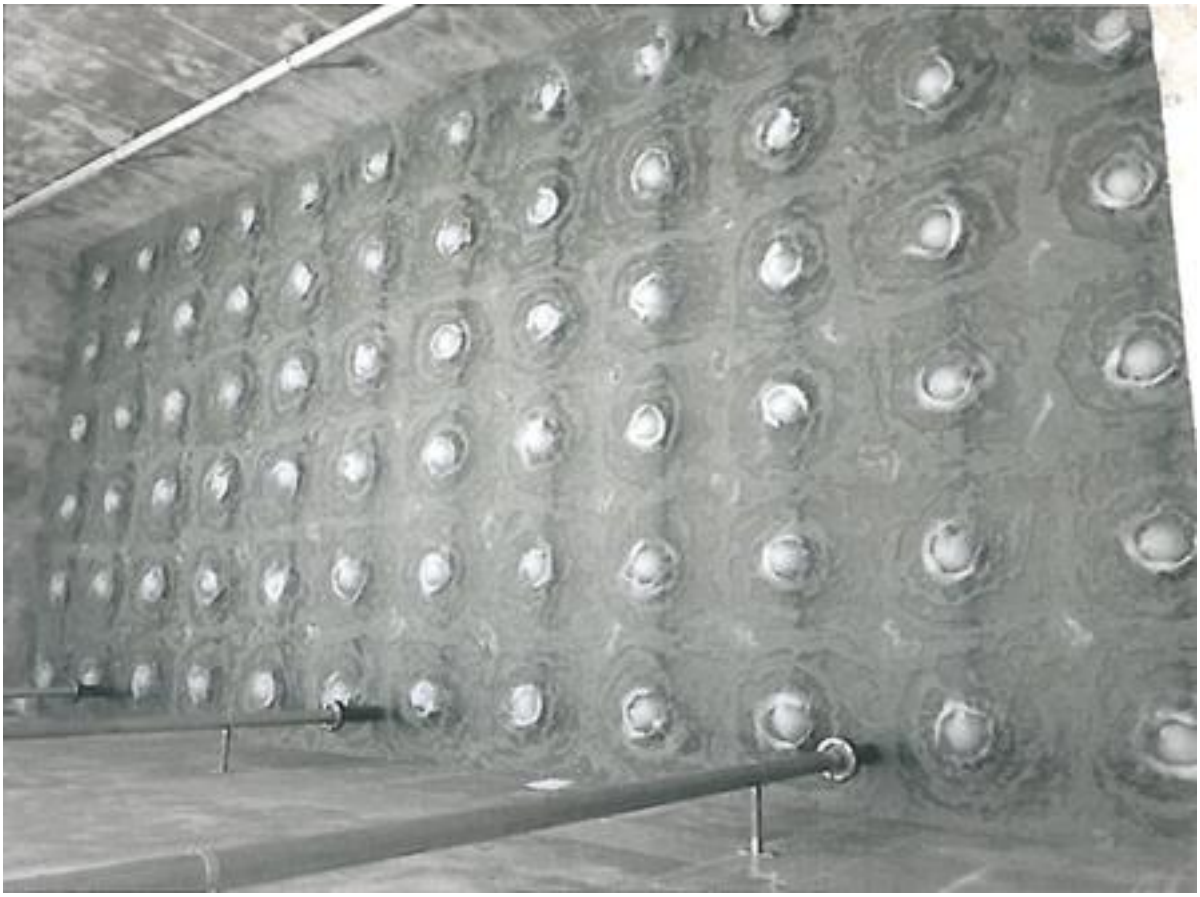


Photo No. 6. Reinforcement of the bottom and walls of the averaging / surge tank.

Photo No. 7. Walls of the averaging / surge tank.

Photo No. 8. Installation of technology at the secondary settling tank.

Photo No. 9. Installation of secondary settling tank technology.

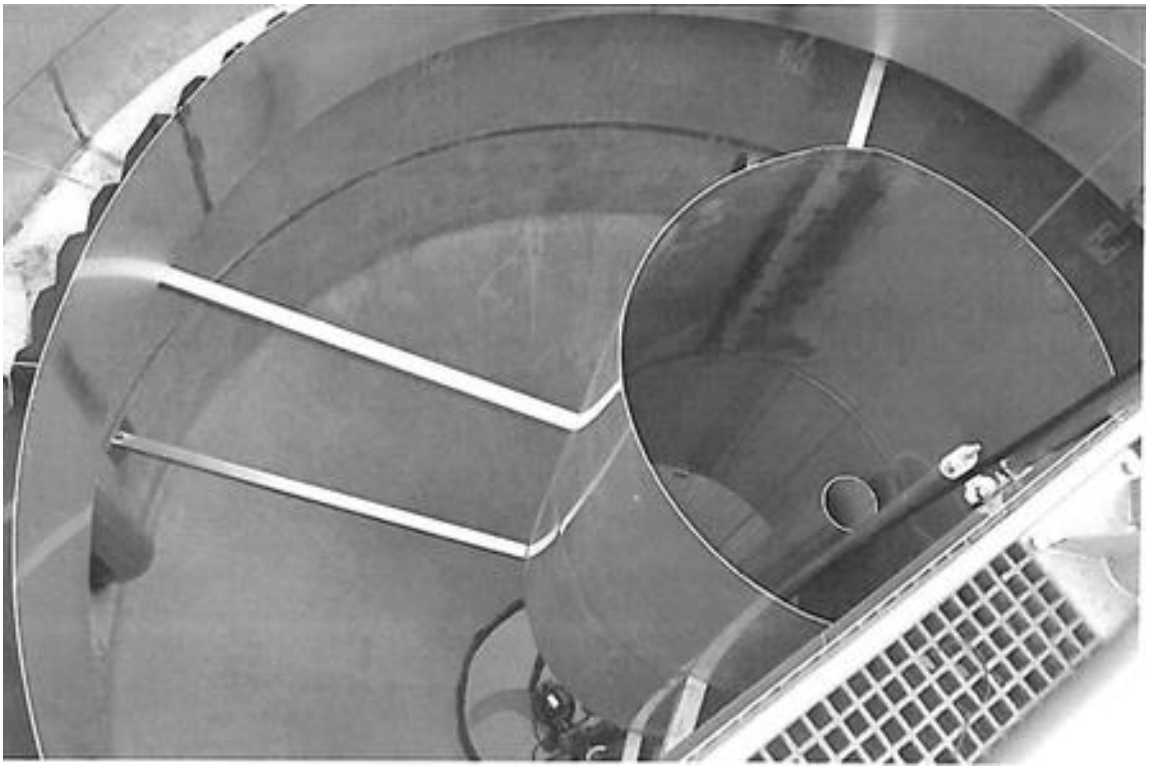


Photo No. 10. Installation of the platform on the secondary settling tank.

Photo No. 11. Reinforcement of filter bed tanks

Photo No. 12. Construction of a deposit storage yard.

Photo No. 13. Reservoirs for filter beds.

PhotoNo. 14. The catchment point for the sewage delivered.

Photo. No. 15. Hardening the surface of the sewage treatment plant.

Photo No. 16. Technological start-up of industrial wastewater treatment plants.

5. Corrections aimed to improve the plant's performance

During the construction works carried out on the construction of a new biomechanical line, at the industrial wastewater treatment plant in Doruchów at ul. Powstańców Wielkopolskich 3 the following modifications were introduced:
- Averaging /surge tank (object No. 2) with a diameter of Ø6m and inside height H of 3.55m was made in a monolithic, instead of prefabricated version. The C30 / 37 concrete was used, of W8 water resistance and F75 frost resistance, in XC2, XA2, XD2 classes, water absorption n <5% and reinforcing steel B500SP. The scope of works does not affect the functional use of the facility.
- Two dolomite reservoirs (objects No. 5) with external dimensions of 2.50m x 6.3m and internal height of H = 1.0m were made in monolithic version, instead of prefabricated. C30 / 37 concrete with W8 water resistance, and F75 frost resistance, and classes XC2, XA2, XD2, water absorption n <5% and reinforcing steel B500SP were used.

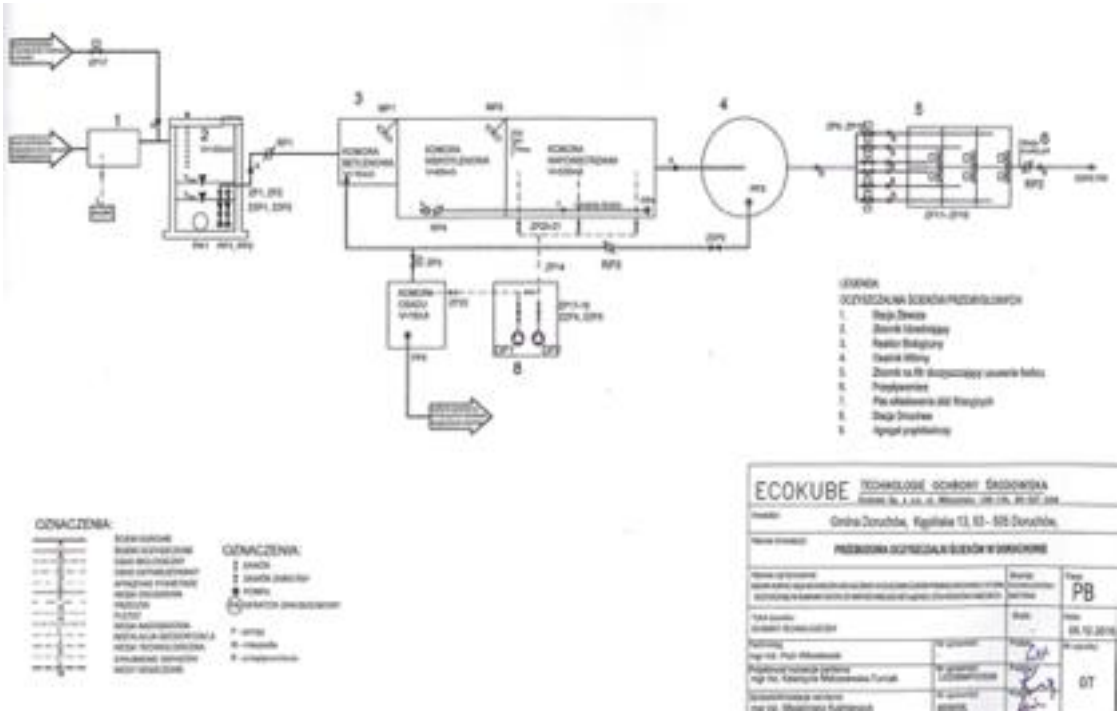
The scope of works does not affect the functional use of the facilities.
Parameters of monolithic tanks do not change in relation to prefabricated tanks.

6. The technology of the plant's work

Raw wastewater from a Meat Processing Plant, Cattle Slaughterhouse and the Poultry Slaughterhouse is collected in the sewage treatment plant in Doruchów. The maximum hourly amount of industrial wastewater discharged for treatment is 10m³ / h, while the average daily amount of industrial wastewater supplied for treatment is 60m³ / day.
The main task of the wastewater treatment process is to remove organic compounds and biogenic elements (nitrogen and phosphorus), which in the aquatic environment cause excessive development of phytoplankton organisms, the so-called eutrophication, leading to oxygen depletion and undesirable changes in the aquatic environment.
The delivered wastewater is received through a catchment station with a capacity of 100m³ / h with the help of a hermetic intake. At the first stage, the wastewater is mechanically treated, flowing into the sieve chamber, where in the perforation zone, screenings (*particles*) are separated. Screenings separated from wastewater on a spiral sieve by means of an oblique conveyor are fed by pressing and dropped into a passing container. The screened sewage, through the sieve perforation zone, flows into the sieve chamber. During sewage discharge, physicochemical parameters (pH, temperature, conductivity) are measured and averaged, and the volume of sewage delivered is counted. Washing and disinfection of vehicles delivering sewage takes place in a catchment station with the discharge of sewage resulting from washing to the averaging tank.
After removing the screenings in the catchment station, industrial sewage supplied and inflowing from the existing main pumping station flows gravitationally to the 100m³ averaging tank, where the sewage composition is averaged by mixing and degassing. A mixing and aeration device - a submersible radial aerator type Aqua Titanic with a capacity of 80m³ / h with a capacity of 3.7 kW is installed in a tank with a diameter of 6 m and a depth of 3.55 m. Two submersible pumps with a capacity of Q = 10m³ / h are used to empty the tank,

placed at the bottom of the tank. Sewage pumped from the averaging tank is pumped to the anaerobic chamber of the biological reactor. There is a sewage level sensor in the tank.
The process of biological wastewater treatment takes place in biological reactors, in which integrated processes of biological decomposition of organic compounds and removal of nitrogen and phosphorus take place. The biological reactor consists of chambers characterized by various oxygen and hydraulic conditions. In each chamber, a specific biological process take place, and each of those require a different oxygen content. The mixture of treated sewage and sludge, which is formed as a result of the bioreactor operation, is discharged from the biological reactor to the secondary settler *(clarifier)*. The clarifier separates the sludge from the treated sewage, which flows through the channel to the reservoirs of the dolomite deposits. In tanks, the wastewater flows through the filter beds with the following parameters: sewage from phosphorus compounds is cleaned, and then the treated sewage goes to the flowmeter chamber and is discharged into the Struga stream from Zalesie.

Fig. No. 17. Technological diagram of the industrial sewage treatment plant in Doruchów.



7. Inflowing sewage test results.

As a result of laboratory tests carried out by an accredited laboratory Spółka Wodna "STREZGOWA" located at ul. Piastowska 105 in Ostrzeszów the following parameters of wastewater flowing into the treatment plant were obtained:

Parameter/ Date	Raw sewage test result as of 25.04.2020	Raw sewage test results as of 26.04.2020	Raw sewage test results as 29.04.2020	Raw sewage test results as 06.05.2020	Raw sewage test results as 11.05.2020
BOT5 [mg/ l O2]	640	5530	460	130	340
COD [mg/ l O2]	1318	11500	1089	324	874
General suspension [mg/ l]	800	11000	660	140	330
General Nitrogen [mg/ l]	170	574	149	99	143
Ammoniacal nitrogen [mg/ l N-NH4]	123	149	132	77,2	106
General phosphorus [mg/ l]	20,2	134	17,3	15,6	11,4
pH at 20oC	7,4	7,1	7,2	7,8	7,8

8. Results of tests on effluent sewage along with the degree of treatment at individual stages of the process.

As a result of laboratory tests carried out on 04.05.2020 till 10.05.2020 carried out by an accredited laboratory Spółka Wodna "STREZGOWA" located at ul. Piastowska 105 in Ostrzeszów ecological effect was achieved. Parameters of treated sewage indicators did not exceed the permissible concentrations of pollutants specified in the Regulation of the Minister of the Environment of November 18, 2014. on the conditions to be met when discharging sewage into waters or into the ground, and on substances harmful to the aquatic environment (Journal of Laws No. 27, item 169).
During commissioning, the optimal technological parameters of the devices operation were determined, ensuring their correct and reliable operation.

The following parameters of wastewater flowing from the treatment plant were obtained:

Parametr/ Data	Max. Value of purified sewage concentrations	Sewage test result as of 04.05.20	Sewage test result as of 05.05.20	Sewage test result as of 06.05.20	Sewage test result as of 07.05.20	Sewage test result as of 08.05.20	Sewage test result as of 09.05.20	Sewage test result as of 10.05.20

		20	20	20	20	20	20	20
BOT5 [mg/ l O2]	<25 mg/l	2,8	2,6	3,5	11	6	3,1	5,2
COD [mg/ l O2]	<125 mg/l	42	40	40	48	37	38	33
General suspension [mg/ l]	<35 mg/l	9,6	27	21	8,7	16	22	<5
General Nitrogen [mg/ l]	<15 mg/l	7,2	8,4	12	10,5	6,5	8,7	8,3
Ammoniacal nitrogen [mg/ l N-NH4]	<20 mg/l	0,6	0,98	0,86	0,44	0,62	0,33	0,98
General phosphorus [mg/ l]	< 3 mg/l	2,2	2,3	2,1	1,8	2,0	2,4	2,2
pH at 20oC	6,5-9,0	6,9	7,2	7,3	6,9	8,7	8,8	8,4

9. Description of the operating parameters of the cleaning filter for phosphorus removal. -

Reinforced concrete tanks were filled with a filter bed with a grain size of 2-6mm with the following parameters:

CaO -43,336%
SiO2 -36,047%
Al.2O3 -5,932%
Na2O- 2,856%
Fe -1,340%
TiO2 -0,96%
MgO -0,938%
S -0,654%

Each of the chambers was filled with a filter bed with a volume of approx. 0.4m³ and a weight of approx. 550kg, and the time of wastewater storage was set on 1 package with a deposit of 60 minutes and 6 pump cycles in the averaging / surge tank. Sewage from phosphorus compounds was cleaned by means of gravitational waste water flow through the bed.

On 09.05.2020 sewage tests results were carried out before inflow to reservoirs. The following wastewater parameters were obtained:

BOT5	COD	General	General	Ammoniacal	General	pH at

[mg/ l O2]	[mg/ l O2]	suspension [mg/ l]	Nitrogen [mg/ l]	nitrogen [mg/ l N-NH4]	phosphorus [mg/ l]	20°C
3,1	38	16	8,7	0,33	6,39	8,4

The effluent after flowing through the filter bed obtained the following parameters

BOT5 [mg/ l O2]	COD [mg/ l O2]	General suspension [mg/ l]	General Nitrogen [mg/ l]	Ammoniacal nitrogen [mg/ l N-NH4]	General phosphorus [mg/ l]	pH at 20°C
3,1	38	22	8,7	0,33	2,4	8,8

The following wastewater parameters have changed on the filter bed:

Parameter	Results of sewage collected before the filter bed	Results of the effluent treated after flowing through the filter bed	Changes
General suspension [mg/ l]	16	22	+ 4,00
General phosphorus [mg/ l]	6,39	2,40	- 3,99
pH at 20°C	8,4	8,8	+0,4

After the wastewater flow through the filtration bed, there was a significant reduction of phosphorus by 62% and the parameters of the total suspension and pH in the wastewater changed slightly.

10.Conditions for carrying out the works

Before commencing the works, we got acquainted with the arrangements and issued decisions. Construction works were carried out in accordance with applicable standards, technical conditions for the performance and acceptance of works, construction regulations and OHS. During the earthworks, mechanical works, transport of materials, extreme caution was observed and all health and safety regulations were observed.

11. Date of commencement and completion of works

The construction site was commissioned on September 4, 2019.
Construction works were completed on February 20, 2020.
The technological start-up was completed on 10.05.2020

Jacek Magnuszewski, sworn translator of English, repertory number 123/20