ContiSeq Kompakt

Technical presentation of a compact, municipal wastewater treatment plant on greenfield basis, using ContiSeq cyclic biological technology - developed by Inwatech

Wastewater treatment plant specifically designed for small scale projects:

1000-2000-3000-4000-5000 PE

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2. Introduction of Inwatech's ContiSeq Kompakt product range

In today's wastewater treatment technology solutions, we are experiencing a shift in the focus from conventional (continuous) wastewater treatment technologies towards highly automated, so-called sequential –SBR- and within that, cyclical wastewater treatment processes that ensures cost-effective and flexible operation. Parallel with this shift the demand for small scale, de-centralized wastewater treatment solutions has been increasing in many parts of the world. Inwatech's answer to this challenge was the **development of the ContiSeq Kompact system**. The goals for the development of such a small scale product family based on our company's patented ContiSeq™ technology were:

- design of small-scale **(1000-2000-3000-4000-5000 PE)** plants
- cost effective engineering
  - pre-assembled, containerized technological building
  - minimum amount of site assembly work
- operator-friendly design
  - streamlined mechanical engineering
  - modest operation and maintenance requirements
  - fully automated operation

With the above design concept, we have eliminated the price sensitivity issue, which is the typical hallmark of the small treatment plants, with **serialized design**, so that the design costs won't burden the investment cost of an individual -small scale- plant.

2.1 Inwatech's ContiSeq™ technology

The **ContiSeq™ technology** is a **cyclical wastewater treatment processes** that ensures cost-effective and flexible operation. The main advantages of the compromise-free, applied biological wastewater treatment technology are the following:

- Exceptional technological flexibility against often highly variable loads
- Uniquely low energy consumption (compared with any other aerobic technologies)
- Simple civil works and mechanical design
- Excellent settling and dewatering characteristics of the biomass
- Thanks to the previous points, outstanding phase separation can be achieved
- Excellent and constantly high quality treated wastewater is produced
- Intelligent aeration control, allowing significant savings on blower operation time.
- Complete biological treatment with biological N and P removal.
- Automatic emergency and rainy period program sections

2.2 Inwatech's ContiSeq Kompakt product range

Our **ContiSeq Kompakt product range** has the same features and advantages as described above, but it has been specifically developed for the requirement of small scale treatment plants. It is a

containerized treatment plant design, highly pre-assembled, competitive product range. Its technological container is fully assembled off site in our workshop. After having delivered to site it requires minimum amount of sitework. The technological connections with the reinforced concrete biological reactor can be done quickly and efficiently. Then the compact effluent plant is ready to go!

The ContiSeq Kompakt product range is available for: **1000-2000-3000-4000 and 5000 Population Equivalent (PE) sizes**, design is according to the German ATV Directive.

2.3 Expected effluent characteristics

Expected treated effluent parameters (can be fine-tuned according to national standards and requirements):

Parameter	Dim	Concentration	Concentration
COD	mg/l	125*	125
BOD_5	mg/l	25	25
Total N	mg/l	10	10
Total P	mg/l	1	5
TSS	mg/l	35	35

* In case the inert (non-biodegradable) COD concentration in the raw wastewater does not exceed the average of 20 mg/l.

3. Main technological units of the system

3.1. The main elements of the developed sewage treatment system on the wastewater line:

- Reception of the wastewater via pressure pipe.
- The raw wastewater is filtered in a drum screen with an outdoor installation, but with winter proof design (partly heat-insulated and heated), usually with a bar spacing of 4-6 mm. For operation safety, a manual bar screen is installed in parallel with the drum screen.
- The filtered wastewater flows by gravity into the (one or) two cyclic, aerobic activated sludge reactors, constructed in parallel configuration. The biological reactors are partially below ground level construction, made of reinforced concrete. These include:
    - Pre-selector or Contactor zones, intermittent mixing with coarse bubble diffusers
    - Multifunctional Selector or Captor zone, equipped with fine bubble aeration system
    - A main reactor zone with fine bubble aeration, equipped with treated wastewater decanter, operating according to a specified cycle sequence and recirculation pumps
- The treated effluent leaves the biological system through the controlled decanter and is discharged by gravity to the recipient.

- **General equipment room (containerized design)**
- **Air blower room (containerized design)**
- **Electrical power cabinets in separate electrical room (containerized design)**
- **Control system cabinet in separate electrical room (containerized design)**

Containerized Electrical Control Room

Containerized Equipment Room)

3.2. The main elements of the developed sewage treatment system on the sludge line:

- A multifunctional sludge thickener and storage tank for the pre-treatment of biological sludge, integrated into the biological tank.
- Compact sludge dewatering technology for intermittent sludge dewatering of pre-thickened biological excess sludge (2-3 times a week). System components: Sludge feed pump, polyelectrolyte make-up station with dosing pump, sludge dewatering equipment with integrated flocculator chamber and wash water system.
- Local control system for the sludge dewatering
- Equipment room for the sludge dewatering system **(containerized design)**
- Storage of dewatered sludge in standard dewatering container

Due to the flexibility of the containerized design, a separate (typically 20') container with the **mechanical sludge dewatering system** can be added to the basic wastewater treatment system as an optional, add-on module.

For further cost reduction, the basic concept does not contain mechanical sludge dewatering system. In this basic concept other sludge handling and dewatering methods can be utilized, such as sludge drying bed or thickened sludge delivery to near sludge centrum.

3.3. Auxiliary units of the technology:

The basic ContiSeq Kompakt technological scope requires a number of auxiliary units for the proper functioning, such as: operator building, power supply (transformer station), mobile genset, final effluent discharge line, metered drinking water supply, access road, fencing and other necessary infrastructure.

3.4. Additional facilities for the wastewater treatment plant - Options:

- Receiving station for liquid sewage from septic tanks, pre-treatment, buffering
- Treated effluent buffer tank and transfer pump station incl. flow measurement (in case the treated effluent cannot be discharged by gravity)
- Disinfection of treated effluent (chemical or UV)
- Post-filtration of treated effluent (tertiary treatment)
- Dewatered sludge storage hall and its related mechanical equipment
- Treated wastewater recycling station (for the purpose of irrigation or industrial water production)
- Air pollution control system (biofilter)
- Garage, workshop, laboratory, warehouse as per request.
- Implementation of energy saving air blowers (optional upon request)
- Remote monitoring system

4. Detailed description of the treatment plant

The planned sewage treatment facility is a compact wastewater treatment plant **with pre-assembled, containerized units, in a modularly constructed structure**, fully integrated with a reinforced concrete structure, it includes the following technological units in its standard configuration:

4.1. Reception and mechanical pre-treatment

Municipal sewage is received inside the multifunctional technological container via a pressure line. Inside the container the sewage is led through an electromagnetic flow meter, then it exits at the top where it is fed into an outdoor type of mechanical drum screen placed over the container. The fine screening is done inside the drum screen with 4-6 mm slot sizes. The screenings is led via a down-comer chute, into a 240 liter plastic container underneath. Parallel with the drum screen, a manual bar screen is installed with 15 mm bar spacing as a safety measure in the event of a machine failure.

4.2. Biological treatment stage

The purpose of the biological treatment of the mechanically pre-treated wastewater is the removal of the remaining organic matter as well as the nutrients (nitrogen and phosphorus) and the fulfilment of the quality requirements for the treated wastewater discharge. The biological treatment stage was designed with the construction of two reinforced concrete reactors that are operated in parallel mode.

The biological treatment stage consists of the following units (symmetrical design, per line):

- 4 pre-selector zones (Contactor)
- 1 post-selector zone (Captor)
- 1 multifunctional aeration zone (Main reactor zone)

The mechanically pre-treated wastewater enters the first chamber of the pre-selector zones (Contactor), which are the first unit of the reinforced concrete reactor, through a plastic splitter box located at the top of the container. Passing through the Contactors, the effluent flows through the post-selector (Captor), then it flows into main reactor zone. The treated effluent leaves the biological reactors through two (one per line) specially designed decanters.

Notes:
Please note that the ContiSeq Kompakt system can be installed also with only one biological line as the most economical solution.

4.3. Treatment process

The planned **ContiSeq™** biological treatment process is an aerobic activated sludge technology with selector principle, usually consisting of two parallel treatment lines. The applied technology works cyclically, but is receiving the raw wastewater continuously.

By default, the reactors typically operate in an 8-cycle operation a day. Each cycle includes filling-aerating, filling-settling, and filling-decanting and sludge removal cycles.

In addition to full carbon reduction, the process also provides full nitrification, maximum denitrification, and highly efficient biological phosphorus removal.

In the main reactor zone, which is designed as a fully mixed reactor, a fine-bubble air diffuser system provides the required oxygen supply. The volume of the air intake is controlled by the cycle program and the dissolved oxygen sensors, 1-1 located in each of the reactors. In addition to measuring the oxygen level, the effluent temperature, the amount of excess sludge and the effluent levels in the reactors are also measured and recorded.

The air supply is provided by a set of air blowers installed in a separate air blower room, located in the **multifunctional technological container**, with 1 blower operating per reactor. A total of 2 blowers shall be established, of which 1 is in operation and the other as a stand-by. The blower in service alternately aerates the reactors in continuous operation. Each blower is equipped with frequency controller.

The reactors have internal MLSS recirculation system, provided by a recirculation pump station. The recirculation pump station is located in the multifunctional technological container. Periodic removal of excess sludge is performed from the MLSS recirculation system, with the means of a set of automatic valves.

The reactors are equipped with special, **remotely controlled** decanters which are also able to control the intensity of the decanting (discharge). The **intelligent program controlling the process cycles and decanter operation** also enables a trouble-free management of peak hydraulic loads without biomass loss.

The combined discharge of the biologically treated effluent is led from the decanters to the recipient by (usually) a gravity discharge line. Final effluent flow measurement and disinfection system is not installed in the basic scope.

4.4. Sludge storage and sludge management

The excess sludge generated in the biological reactors is pumped to the sludge storage-thickener tank. The tank is equipped with aeration system for ensuring the homogenization of the sludge.

After gravity thickening of the sludge, clear water layer forms on the upper part of the tank, that can be removed by a decanter pump. From the bottom of the basin, the thickened sludge is removed by means of a progressive cavity pump and it is pumped to a belt filter press. The feed pump is equipped with frequency controller.

The belt press (optional system) dewaters the pre-thickened sludge to a minimum solid content of 14%. The dewatered sludge discharged from the belt press falls through a hopper into a container placed under the equipment, from where the container can be removed by truck.

Supernatant from the press flows back to the beginning of the biological process by gravity. Polyelectrolyte is used for conditioning the sludge.

The **complete sludge dewatering station**, including the dewatering unit with all its peripheries is installed on top of the technological container, next to the drum screen, in a 20' container as a separate, **optional module**.

4.5. Leachate and chemical storage and dosing

The leachate network at the site is not part of the basic scope of the ContiSeq Kompakt system. The small amount of leachate to be returned to the sewage treatment plant is the communal wastewater from the operator's building and/or the leachate water that accumulates periodically during cleaning or servicing, collected in the floor drainage system in the technological container. These leachate waters are returned to the mechanical screen by a compact wastewater lifting station equipped with grinder pump. The additional organic load resulting from the leachate water was taken into account during the design of the biological process.

If the nutrient level of the incoming wastewater or the treated effluent discharge limits requires it, it is possible to dose a liquid chemical. For this purpose, a double-walled, HDPE chemical storage tank shall be installed in the technological container with one chemical dosing pump, mounted on the top (part of the basic scope).

Due to its small, overall capacity of the treatment facility, a separate receiving station for liquid sewage from septic tanks is not considered in the basic design scope.

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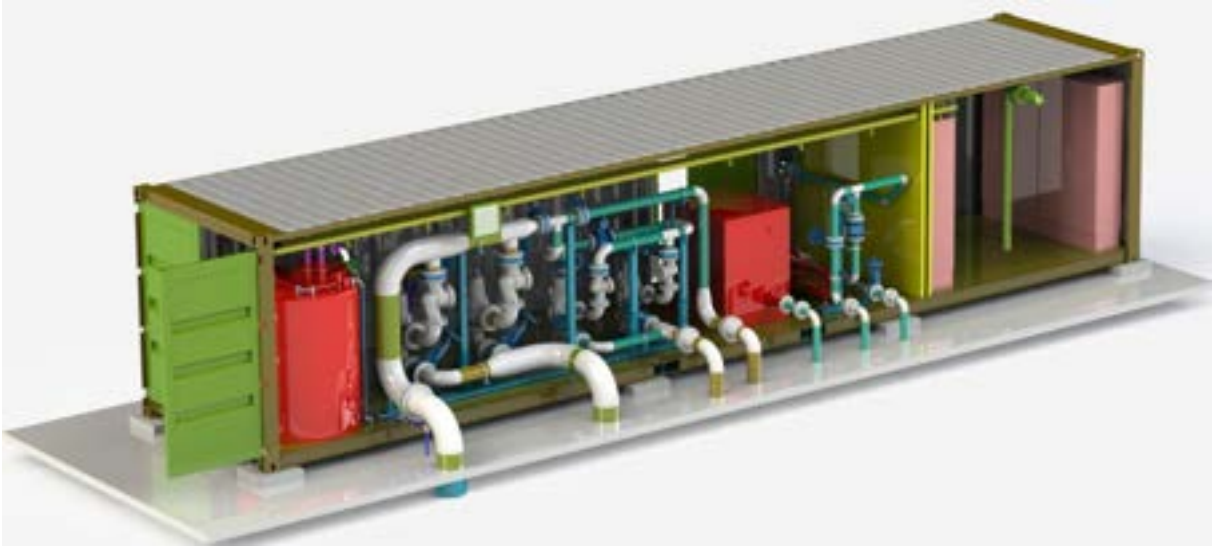

Containerized Equipment Room -typical

Appendices

- ContiSeq Kompakt-01_Layout plan - typical
- ContiSeq Kompakt-02_Reactor layout - typical
- ContiSeq Kompakt-03_T.container -typical