New Version of DWA-worksheet for the design of wastewater treatment plants with activated sludge systems according to DWA-A 131

Norbert Meyer, BITControl GmbH

In June 2016, a new directive for the design of wastewater treatment plants with activated sludge systems was published. Currently, the design software has to fulfil the conditions of this worksheet if the result uses to be according to german or european conditions. This also affects other worksheets.

AQUA DESIGNER was adapted to the new conditions as one of the first applications and all parts of the huge amount of tools are now complying with the requirements of the directive.

Fundamental Changes

The basic design was changed from BOD to COD. So, all algorithms are completely different to the former valid document ATV-DVWK-A 131. The design software AQUA DESIGNER had to be totally rearranged and we used this requirements to improve the interfaces and to deliver more possibilities and information.

Loads/Inflow

The general recommendations for the specific loads are still the same. Only the degradation of compounds in the primary sedimentation increased a little bit.

<table>
<thead>
<tr>
<th></th>
<th>May 2000</th>
<th>June 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 0.5 h</td>
<td>0.5 - 1.0 h</td>
</tr>
<tr>
<td>Raw Wastewater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOD₅</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>COD</td>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XCOD 45%</td>
</tr>
<tr>
<td>DS</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td>TKN</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>P</td>
<td>1,8</td>
<td>1,6</td>
</tr>
</tbody>
</table>

Table 1 A131/2000 and Table 2 A131/2017

Inhabitant-specific loads in g/(lxd), which are undercut on 85% of the days, without taking into account sludge liquor.
Defining the Load

**Aerobic Sludge Age**

The form for the aerobic sludge age is still the same. The Safety Factor for nitrification is replaced by the Process Factor. The selection of the Process Factor differs from the former Safety Factor selection. It is no longer selected depending on the People Equivalents but based on the Peek Factor $f_n$ and the Nutrient Outflow Requirements. That can lead to a higher Process Factor for larger plants while for the old model the Safety Factor was smaller for bigger plants. So the Aerobic Sludge Age can increase.

**Denitrification Capacity**

Due to the change of the calculation basis from BOD to COD, the form for the denitrification capacity is different. For Separate Stage Denitrification the denitrification capacity is slightly higher, for intermittent denitrification it is lower than with the A131/2000. So by using intermittent denitrification, the effect can be that the necessary volume will increase, although there is a higher C-separation in the primary settling tank because the denitrification ratio increases with lower denitrification capacities.
Designing the biological stage

**Oxygen and Air Demand**

To calculate the oxygen and air demand, the DWA-A 229-1 can also be used. Here the evaluation of the highest and lowest oxygen and air demand is defined. The calculation with the A 131/2017 gives a lower oxygen demand but in combination with the A 229-1, the oxygen supply and the air volume are higher than with the A131/2000 because for the load evaluation of the valid case both peak factors fC and fN have to be considered. In the old version of the A 131, it was required to calculate one case with fN and one case with fC and then to take the most unfavorable case.

To evaluate the oxygen demand, 4 load cases have to be verified. This is implemented in AQUA DESIGNER with a new user interface with lots of possibilities for defining parameters. This part in AQUA DESIGNER is a very powerful tool to proof or verify existing plants or chambers.

Furthermore, it is possible to choose different sizes of blowers to get a good gradation of the blowers’ capacity to the minimum, average and maximum air demand. The blowers are provided in an extensive machine data bank.
Load Cases, Oxygen and Air Demand and selection of blowers and mixers

SBR
The guideline DWA-M 210 for designing SBR-Systems is also based on the A 131. The basic volume for the biological processes is first designed with the DWA-A 131. Then, this is converted to the cycles of the SBR-process. So in AQUA DESIGNER also the design of SBR-Systems has been adapted to the actual requirements.
SBR Design based on A 131 and M 210

**Sludge Treatment**

For the sludge treatment the DWA-M 368 is valid. After calculating the biological part and the primary and excess sludge amount, AQUA DESIGNER provides tools for designing the sludge treatment and gas use for the production of heat and electricity.
Design of anaerobic digester and mass balance

Tools

AQUA DESIGNER has a couple of tools to generate additional results based on the dimensioning.

- detailed reports of all calculations
- Operation Costs
- Pipelines
- Oxygen Efficiency
- Buffer Tank
- True Scaled Drawings
- Excavation
- Buoyancy
- Verification of existing sedimentation chambers

Literature

/1/ Arbeitsblatt DWA-A 131
    Bemessung von einstufigen Belebungsanlagen
    DWA, Hennef, Juni 2017

/2/ Standard ATV-DVWK-A 131E
    Dimensioning of Single-Stage Activated Sludge Plants
    ATV-DVWK, Hennef, Mai 2000

/3/ Advisory Leaflet
    ATV-DVWK-M 368E
    Biological Stablisation of Sewage Sludge
    ATV-DVWK, Hennef, April 2003

/4/ Merkblatt DWA-M 210
    Belebungsanlagen mit Aufstaubetrieb (SBR)
    DWA, Hennef, Juli 2009

/5/ Merkblatt DWA-M 229-1
    Systeme zur Belüftung und Durchmischung von Belebungsanlagen
    Teile 1: Planung, Ausschreibung und Ausführung
    DWA, Hennef, Mai 2013

/6/ Arbeitsblatt DWA-A 202
    Chemisch-physikalische Verfahren zur Elimination von Phosphor aus Abwasser
    DWA, Hennef, Mai 2011

Norbert Meyer
10.02.2017, BITControl GmbH, Nattenheim
www.bitcontrol.info
norbert.meyer@bitcontrol.info