aquen
Effizienssteigerung im Klärprozess

White Paper

A new method for optical detection and measurement of flocs in flocculation and dewatering processes (for in process and laboratory use)

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Flocs in the treatment process:

The processes for the treatment of wastewater are continuously optimized, a task for the responsible treatment plant managers and their teams. New measurement and control techniques and a steadily growing experience have contributed to a continuously process optimization.

The starting point:

A reliable system for online evaluation of flocculated particle systems (flocs) was in the technology and measurement field not available. A monitoring and control to optimize the dewatering processes was therefore difficult to achieve. On the other hand, the dewatering of a flocculating system can only be assessed qualitatively by means of the flocs.

To assess the quality of flocs are mainly of interest:

- The floc size distribution and its temporal change
- The shear stability of the flocs
- The quality of the flocs (floc form) affected:
  - The effectiveness (quantity and quality) of flocculants (influence on the flocculation)
  - The drainage of the conditioned sludge (increase of the drainage rate)
  - The separation quality of the downstream drainage level (water quality)

Results: With regard to the quality of flocs in the process is a higher dewatering capacity at reduced polymer used safely possible.

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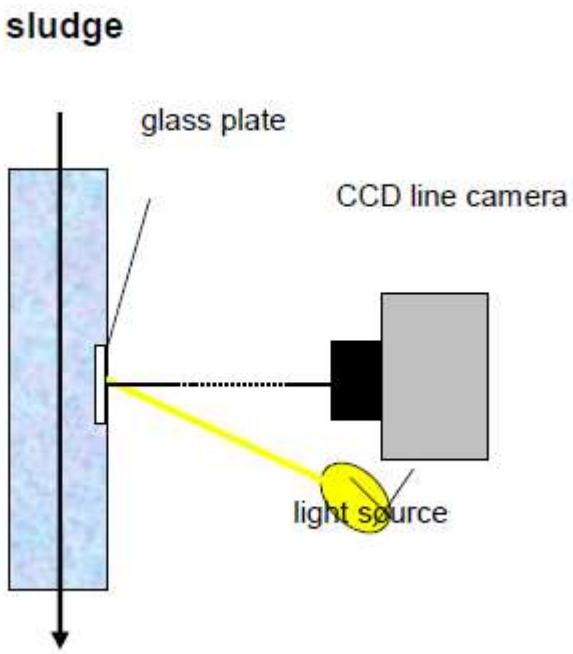
The dewatering process

In wastewater treatment, polymer-initiated thickening and dewatering processes have long been a central part of the lawsuit. More recently, flocculation processes are also increasingly used in other areas to be separated from a medium of certain ingredients may, for example in the paper industry. Historical reasons set the current focus primarily on the separation machines themselves, little attention has, however, the generation of optimal floc for the separation process. With the new focus on optimizing the separation stage as the last process step, this has now changed dramatically. Thus the flocculation process moves as a central component in the field of view. An optimal and reproducible floc structure but without measurement acquisition is very difficult to achieve.

Example: Generating Flocs

The Floc Sensor



Schematic of the Sensor

The photo-optical Sensor is an online instrument that is used to measure the size and structure characteristics of dispersed and undispersed solid systems. The sensor works in situ, it can be mounted directly into an existing production line and / or will be operated in the bypass.

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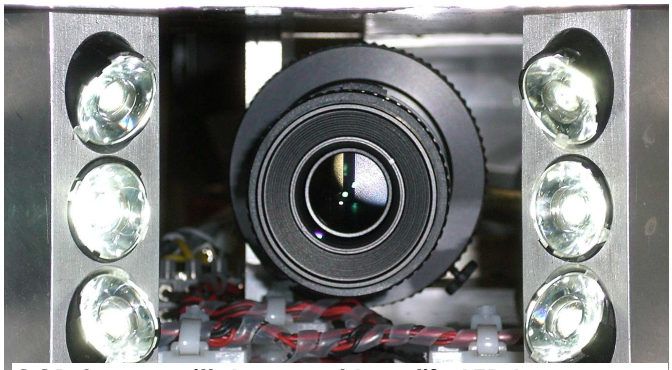
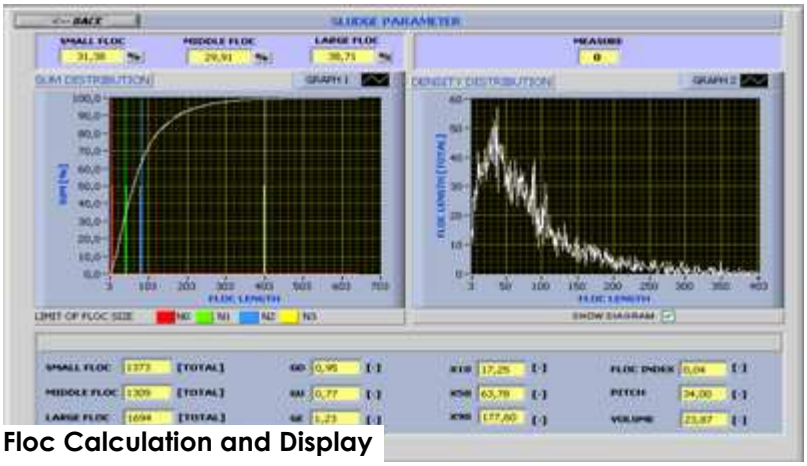
The FlocSens works as a reflective instrument, with the measuring surface illuminated by light. The property to be examined is taken through a viewing window and then analyzed. A CCD line camera measures upright and perpendicular to the flow direction of the particle system.



CCD Sensor with Lens and Longlife LED Lamps

The measuring range is from 50 µm to 2.9 cm. The analysis is one-dimensional and long-length oriented, robust and little susceptible to interference. The calculation of specific characteristics is based on chord length, number density and cumulative distributions. These are in a PC very quickly calculated in large numbers, giving a very timely statistically reliable particle or structural features, nearby Realtime.



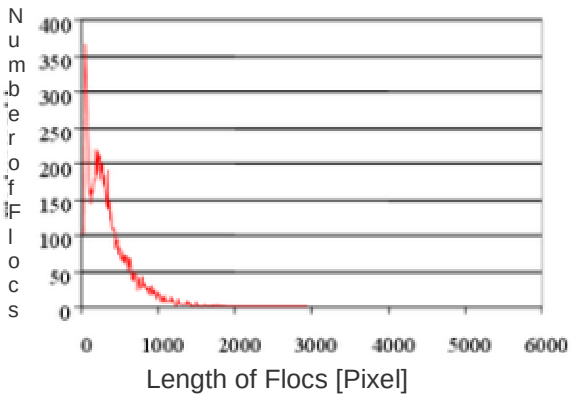
Floc Calculation and Display

The image shows the output of a measurement result derived from the visual examination of the flocs. From the raw data of the sensor are calculated in a downstream processing unit the relevant process variables and displayed visually. Normalized values can be passed to control and regulation systems. This can be 4-20mA or similar Signals, depending on the needs.

For the reader it is certainly helpful to look at an example.

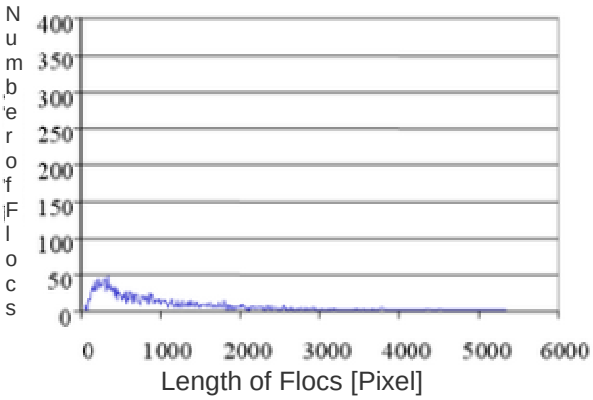
Figures of typical Flocs from the daily practice of wastewater treatment plants:

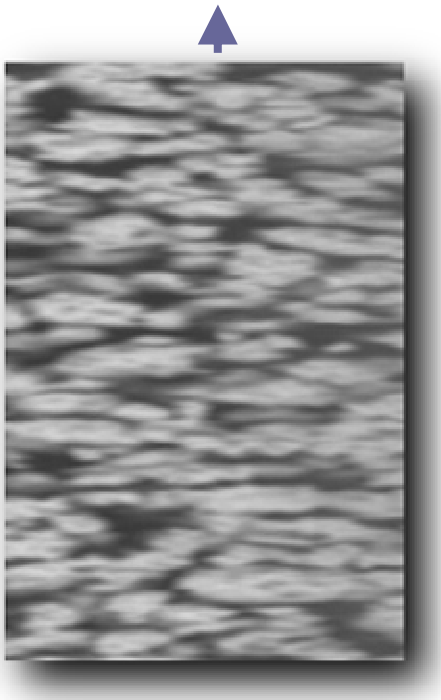
Poorly drainable flocculation:
- High number of small flocs
- Residual turbid water



FlocSens Picture

Flocculation good drainable:
- Good Floc Pelletts
- clear residual water





FlocSens Picture

(Line-Sensor, multiple lines added to a Picture)

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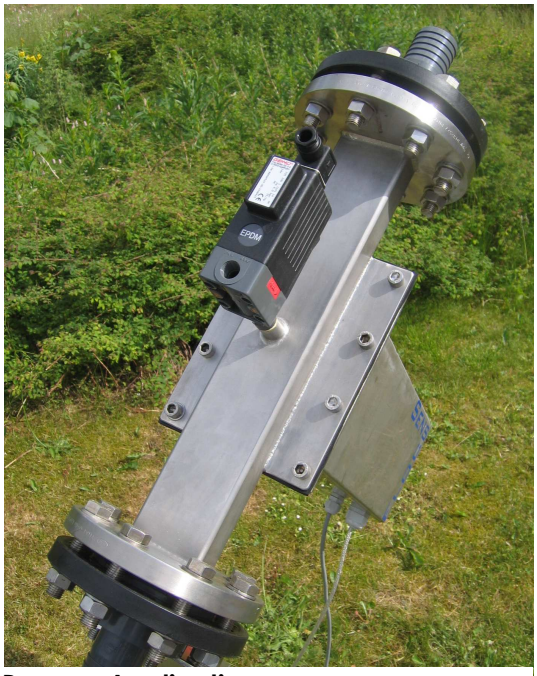
The left figure (red line) shows the high number of small flocs and particulate matter (peak at very small flocs lengths), the right one (blue line) a well-recognized "rough" pelletising the flocs, a precondition for easy drainable sludge.

The software of image analysis is of modular and scalable design so that the evaluation routines can be adapted to various material systems. The calculated values are process-specific and can be calibrated for the specific application.
In addition to a measurement, for example for quality control of flocculation, a process regulated by the FlocSens is possible. By the sensor, several specific characteristics, such as flocs, floc size and structural characteristics are recorded separately. A system of individual actuators in a structure or forming system can thus be realized. Through its installations could be shown that the FlocSens can determine the level of conditioning with regard to the freeness of the treated sludge. The correlation of the sensor-en-calculation is actually achieved on the drainage characteristics at > 0.95, a high predictive power.
The measuring system is available for stationary applications in the process as well as for laboratory applications.

The mechanical design (Process application)

In stationary applications, the sensor in situ, it can be mounted directly into an existing production line and / or promotion will be incorporated as operated in the bypass. For this application, pressures up to max. 65 bar are allowed. The laboratory version (see below) can be used for example the floc size distributions or the shear stability in dependence on the analysed flocculants. Thus, a reproducible polymer screening is performed. The results are highly applicable to large industrial applications.



Process Application

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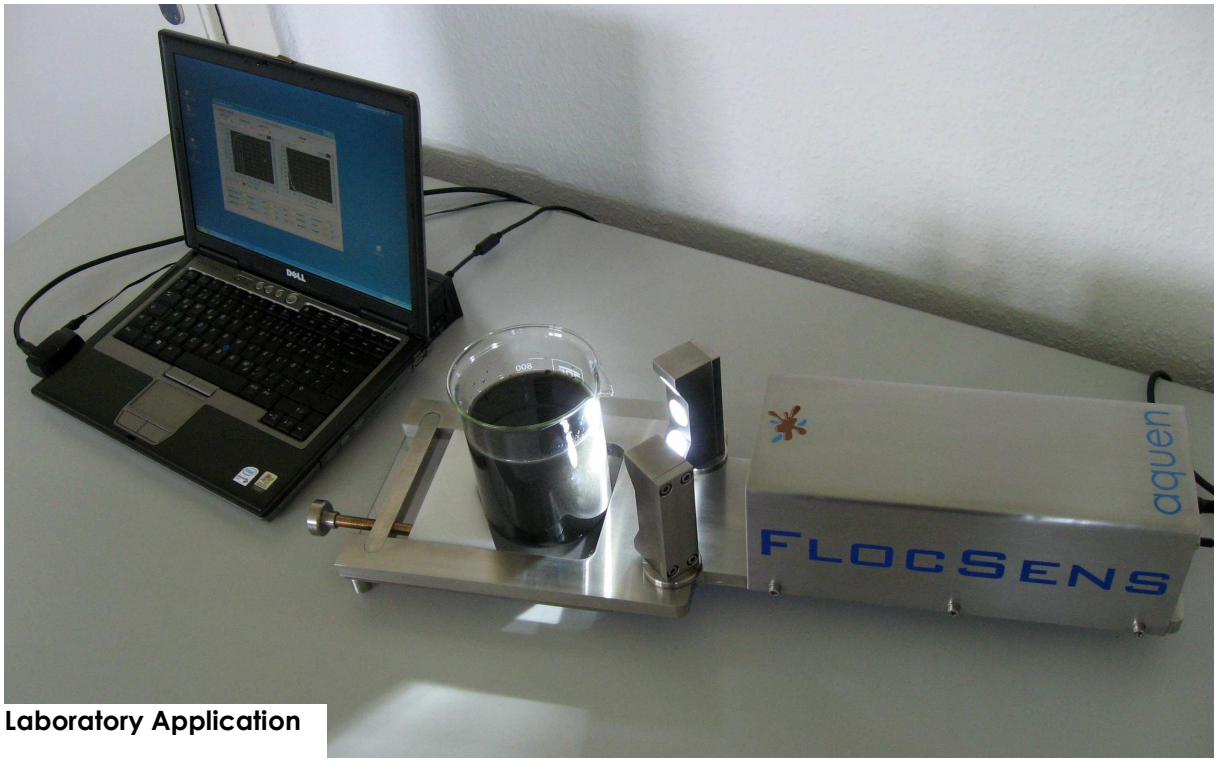
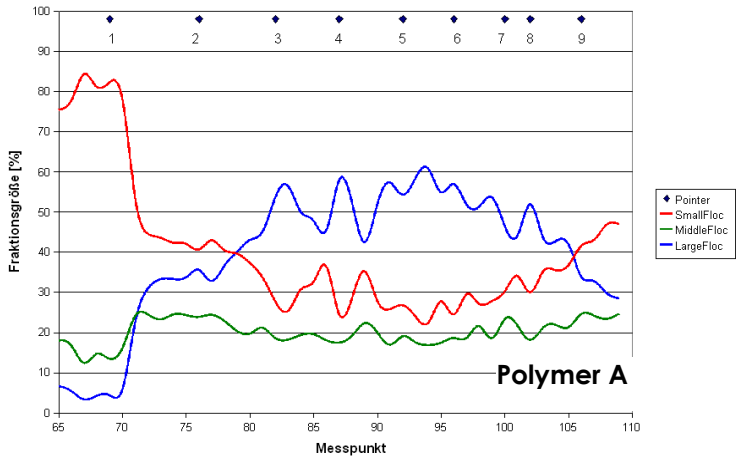
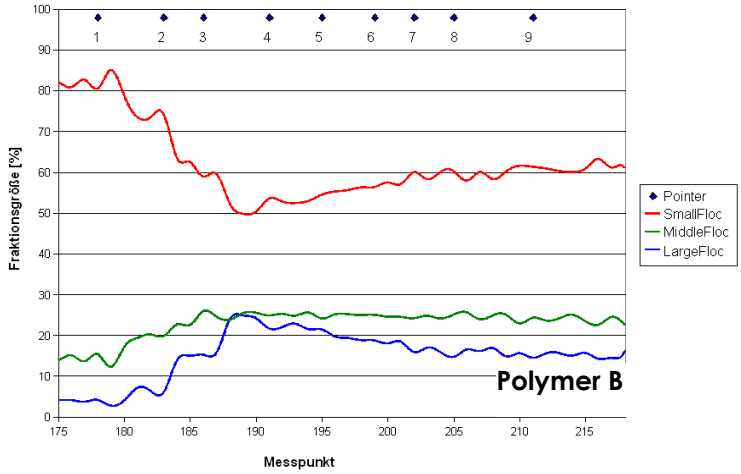


Laboratory Application

Laboratory Application (Example)

As an example of a typical laboratory use, the flocculation behavior of two different types of polymer A and B is characterized by a sludge floc size and floc stability. Also analyzed the content of the flocs sensor stirred beaker. At the beginning of yet untreated sewage sludge is stirred. Then the first addition of a specific amount of polymer is (see mark 1 in the diagram above). The particle size distributions are changed after the addition. In diagram A polymer decreases the number of small structures (red graph), immediately decreased significantly.





A diagram with polymer B, the number of small structures is only after further addition of polymer

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(marks 2-4) decreases significantly. Reciprocal increase the fraction sizes of large structures (blue).
With further stirring, at additional (markers 5-7) are then made polymer dosages. On the graph, the horizontal course stability of the produced flocs can be estimated. At the time of the markers 8 and 9, the agitator speed defined increased, thereby increasing the shear forces introduced. The behavior of the flocs under the increased shear conditions allows to draw conclusions about the long-term stability of the formed flocs.
The result of the comparison of polymer is that polymer A is due to the rapidly emerging large flocs suitable for primary filtration. Polymer B is preferred because of its relatively small and stable flocks for a drainage in the centrifugal field.

Other applications for the FlocSens Sensor are everywhere conceivable where flocculation is used for dewatering processes.

Examples, without claiming to be complete:

- Paper manufacturing,
- Fruit juice production,
- Wastewater treatment,
- Sludge treatment and
- Thickening Processes.

Get advice for your application.

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