

## Crystalactor® Smart Controls

Self-learning Crystalactor® controller leads to better performance and lower operational costs



### Crystalactor® technology

The Crystalactor Controller strives for maximizing the crystallization surface by timely removing large pellets from the reactor and maintaining an optimal fluidized bed height. The reagent dosed can therefore be maximally effective and overdosing is prevented. This in turn reduces, or even eliminates, the need for reagent neutralization in the reactor effluent. Additionally, maximizing the crystallization surface and effectiveness reduces the potential for spontaneous nucleation in the water phase. Consequently, less suspended solids are present in the reactor effluent. When applicable the downstream polishing filters are loaded less heavily, resulting in less rinsing.



### Why Advanced Control?

The pellet-bed management is critical to the operation of the pellet reactor. The distribution of pellet diameters should be such that there is sufficient surface area for crystallization while the settling rate of the pellets is sufficiently high. This depends on (waste) water temperature, flow and constitution and can be controlled by machine learning, which adjusts the dosage flow, recirculation flow and pellet discharge and sand supply.

### Process optimization

The Crystalactor® is provided with a Virtual Operator, which is an advanced control system that applies self-learning algorithms to predict and control the crystallization processes. The added-value of the controller is based on more than 10 years of (award winning) modelling of the fundamental processes and hydrodynamics within fluidized bed crystallizers.

### Benefits of the Crystalactor® Controller

- Reduced chemical consumption and hence costs.
- Process robustness, which leads to significantly reduced operator attendance, less maintenance and higher capacity availability.
- Optimized process performance which leads to savings in operational costs for back-washing of eventually present downstream carry-over filters.
- Dashboards for a clear overview of the Crystalactor performance.

### Automatic tuning

Adjusting important process parameters like pH, reagent dosing, sand supply and pellet discharge in case of varying treatment capacities and water composition, may ask for good process understanding by the operator. The Crystalactor Controller easily and automatically tunes the relevant set-points and as a result maintains optimal process conditions without the need for adjustments by the operator.

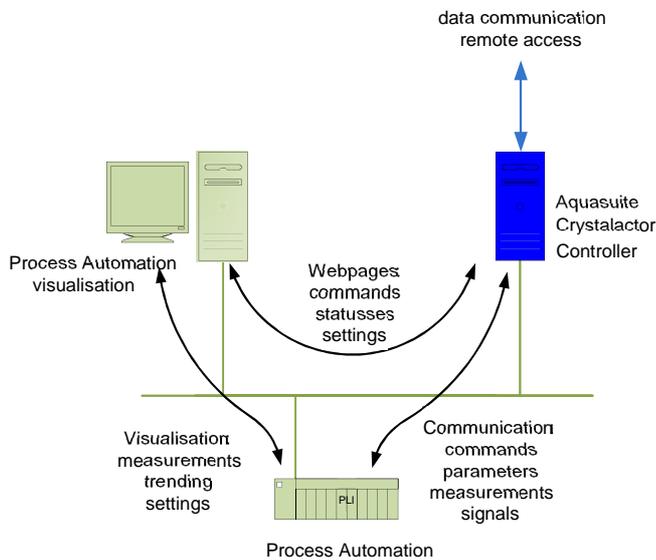
The controller virtually enables the operator to “look into the crystallization process” and makes optimized 24/24h performance reliable and easy.

### Early warning

Depending on preference of the operator, the Crystalactor Controller can – in manual mode – be used as early warning and expert system to assist the operator by recommending optimal setpoints for the Crystalactor operation, whereas in auto-mode the controller communicates these setpoints directly to the plant's general control system (SCADA, PLC, DCS, etc.). In addition, the controller can be used for remote support of the process or for regularly transfer of operational data to Royal HaskoningDHV's central data center for performance evaluation and remote process operation support.

### Easy implementation

The Aquasuite® Crystalactor Controller is an easily implemented add-on to the standard process control system (SCADA, PLC, DCS, etc.). The Crystalactor Controller software can run on any type of computer connected to the control network. The Crystalactor Controller reads signals from the process control system and sends back optimized setpoints for chemical dosing, pellet discharge and sand supply. The operator can always select whether the process control should apply the Crystalactor Controller setpoints or not. Basic control functions are still and always available in the plants process control.



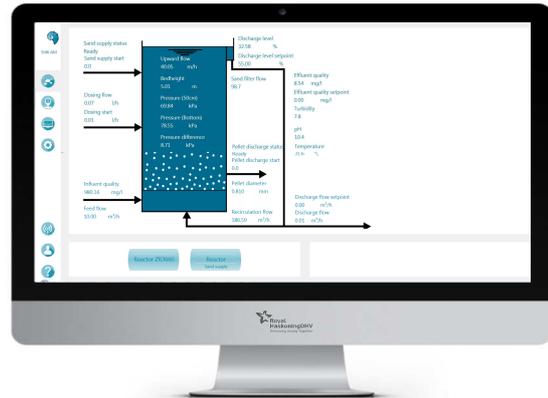
Additionally, the Crystalactor Controller is monitored using a Watchdog signal between the plant control system and the Crystalactor Controller. In case of a hardware malfunction, the local plant control will take over.

### Requirements

*Access for remote log-in to the Crystalactor Controller.* Remote connection should allow Royal HaskoningDHV to operate the Crystalactor Controller and to transfer data and files to and from the Crystalactor Controller. Contact details of responsible operational and/or maintenance personnel (Plant Contact Person) for the water treatment plant.

### User-friendly

The Crystalactor Controller generates operator friendly webpages for visualization of status, settings, measurements, calculations and trendings. These pages can be easily viewed on any computer on the network and/or integrated into the standard visualization system.



Finally, the Crystalactor Controller collects relevant operational data for thorough analysis and can be used for remote process operational support from Royal HaskoningDHV.

### Operational Support

For newly installed Aquasuite® Crystalactor Controllers we provide at least 1 year Operational Support. During this Support:

- The Aquasuite® Crystalactor Controller software will be upgraded yearly with the latest release. This upgrade is installed through the remote connection;
- Standby service by phone and/or email with remote log-in when requested to help trouble shooting process technology and operation and software/hardware issues related to the Aquasuite® Crystalactor Controller. Response to any enquiry related to Crystalactor by email and/or phone within two working days is guaranteed;
- Yearly Crystalactor performance evaluation report;

### Partnership

The Aquasuite® Crystalactor controller has been developed in close collaboration with the Delft University of Technology and Amsterdam Water Works (Waternet), which is Royal HaskoningDHV's long-term partner for development of the proprietary Crystalactor process.

### Aquasuite® software

The Crystalactor Controller is available for industrial and municipal Crystalactor treatment plant targeting water softening, fluoride, phosphate or metal removal/recovery. It is part of Aquasuite®, a Royal HaskoningDHV software suite for advanced process control and monitoring of various water treatment and water distribution processes.