ABJ™

OPERATION OF THE ICEAS® PROCESS

ICEAS EQUIPMENT

Operation of the ICEAS process is facilitated through the use of simple mechanical equipment and state-of-the-art controls. Although the ICEAS process technology is conceptually sophisticated, its mechanical simplicity is elegant and is operationally reliable. The system uses a limited number of moving or powered components and a simple control system. The ICEAS process uses the following equipment to provide a completely functional system:

- Decant Mechanism
- Blowers
- Control System
- Aeration System
- Waste Sludge Pumps
- Air Control Valves

Operation of the equipment listed above in conjunction with the ICEAS process is discussed in this section.

ABJ ICEAS NIT PROCESS

The typical ICEAS-NIT normal cycle as discussed in the process section is 4.0 hours or 240 minutes in duration. The cycle is divided as follows:

Air-on:	120 minutes
Settle:	60 minutes
Decant:	60 minutes

The typical storm cycle operation in the ICEAS-NIT is configured as a 3.0-hour cycle or 180 minutes in duration. Similar to the normal cycle, the storm cycle is divided as follows:

Air-on:	90 minutes
Settle:	45 minutes
Decant:	45 minutes

In the NIT normal cycle, the aeration phase is split into 3-40 minute segments (or 3-30 minute segments during storm cycle). The operator has an option to select the span of aeration during the 40-minute segments. The first two 40-minute segments will operate with air-on followed by air-off. The sequence is reversed in the third segment, which will operate with air-off followed by air-on.

ABJ ICEAS NDN PROCESS

The typical ICEAS-NDN normal cycle as discussed in the process section is 4.8 hours or 288 minutes in duration. The cycle is divided as follows:

Air-on:	96 minutes, 4-24 minutes
Air-off:	72 minutes, 3-24 minutes

Settle: 60 minutes
Decant: 60 minutes

The typical storm cycle operation in the ICEAS-NDN is configured as a 3.6-hour cycle or 216 minutes in duration. Similar to the normal cycle, the storm cycle is divided as follows:

Air-on: 72 minutes, 4-18 minutes
Air-off: 54 minutes, 3-18 minutes
Settle: 45 minutes
Decant: 45 minutes

The seven segments of air-on and air off phases are alternatively applied. The operator has the flexibility to adjust the 0-24 (or 0-18) minute phase per basin through HMI to optimize the process performance.

DECANTER OPERATION

DECANT MECHANISM

The decanter is designed to remove clarified effluent from the top of the basin during the decant phase of the operational cycle. It is installed on the basin wall at the end opposite from the pre-react zone. The decanter is lowered and raised using an electro-mechanical actuator. The actuator moves between top and bottom limit switches whenever the decanter is in operation ensuring that the decanter travels from the "park" position to the bottom water level (BWL). The decanter is parked above top water level (TWL) during the aeration and settling phases of the cycle, thereby eliminating any possibility of solids carryover during these periods.

The decanter speed is controlled by a series of pulses or through use of a variable frequency drive (VFD). As a result, the decanter discharge rate is relatively constant from the time the decanter enters the water to the time it reaches the bottom water level (BWL).

DECANTER OPERATION

During the decant phase, after receiving a signal from the PLC, the decanter travels from the "park" position to the design bottom water level (BWL). Upon reaching the BWL, the decanter will pause for a few minutes to ensure completion of the discharge flow over the weir. The decanter then returns to the "park" position, where it will remain until the start of the next decant phase.

At park position, the decanter provides "fail safe" overflow protection in the event of a power failure. Settled supernatant will flow via gravity over the decanter weir and into the effluent collection system. The decanter scum guard float will prevent the carry over of any floatables during such emergency periods.

The decanter *does not require effluent valves, valve vaults, flexible joints, throttling arrangements or dewatering supports*. This eliminates the costs associated with these components and the risks associated with valve failures (i.e. solids carryover and effluent quality deterioration.)

The decanter weir is always visible from the basin walkway. This feature provides the operator with a continuous visual check of the effluent quality, *a feature not available with floating or fixed decanters*.

Redundant limit switches are provided on the actuator to ensure reliable operation whenever the decanter is in motion. The limit switches are fully integrated with process control time overrides and interlocks, thereby eliminating the potential for blower activation during decant.

The decanter mechanism can be used to optimize disinfection system operation downstream of the ICEAS process. A float switch can be installed on the decanter weir, which will contact the water surface before the decanter, thereby activating the disinfection system prior to discharge of the treated water.

AERATION BLOWER OPERATION

AERATION BLOWERS

Air is supplied to the aeration system in the basin using aeration blowers. The blower size is based on the process air requirements defined by the influent flow and loadings. Both positive displacement and centrifugal blowers are used in wastewater treatment. Blower operation can be optimized through the inherent flexibility of the ICEAS process and utilization of some of the control techniques discussed below.

BLOWER CONTROL

The blowers, piping and air control valves are configured to suit the process requirements of the project and to maximize the flexibility in the plant operation. Blowers can be arranged in various configurations (i.e. one primary blower at 100 percent capacity or one primary blower at 50 percent capacity and one secondary blower at 50 percent capacity) depending upon design preferences. In most cases, one 100 percent capacity spare blower will be provided. See drawing No. 700.

The typical control strategies available for blower operation are listed below:

- PD or Centrifugal Blowers: Start & Stop – Without DO Control
- PD or Centrifugal Blowers: Start & Stop – With DO Control
- PD Blowers with VFD's: With DO Control
- Centrifugal Blowers with Inlet Valve: With DO Control

PD OR CENTRIFUGAL BLOWERS: START & STOP – WITHOUT DO CONTROL

In the absence of the mechanism to control blower output and DO measuring device in the basin, the air supply to satisfy the oxygen requirements can be controlled by starting and stopping the blowers. This is typically done as shown in the following example:

Example:
Assume the ICEAS process is under normal cycle operation. Based on the flow and loadings, it is determined to lower the air requirements by 50 percent to the ICEAS basins. The above scenario under ICEAS-NIT and ICEAS-NDN process are described below:

NORMAL CYCLE IN NIT MODE

The operator enters 20 minutes for air-on time per 40-minute segment on the HMI. This would result in the following cycle:

Air-on:	60 minutes, 3-20 minute segments
Air-off:	60 minutes, 3-20 minutes segments
Settle:	60 minutes
Decant:	60 minutes

This feature is typically utilized during start-up of the plant or during initial years of operation where low flow and loading conditions prevail.

NORMAL CYCLE IN NDN MODE

The operator enters 12 minutes for the air-on time per 24-minute segment on the HMI. This would result in the following cycle:

Air-on:	48 minutes, 4-12 minutes
Air-off:	120 minutes, 3-40 minutes
Settle:	60 minutes
Decant:	60 minutes

Essentially, the reduction in the air-on time is converted to air-off time by keeping the segments of settle and decant unchanged.

PD OR CENTRIFUGAL BLOWERS: START & STOP – WITH DO CONTROL

Dissolved Oxygen concentration in the basin can be controlled by starting and stopping the blower. Under this operating strategy, the operator enters a low DO set point and a high DO set point through the HMI. The blower runs until the high DO set point is reached. Once this has occurred, the blower shuts down. When the low DO set point level is reached, the blower starts again.

PD BLOWERS WITH VFD’S: WITH DO CONTROL

DO can be controlled by using a VFD with the PD blower. The operator enters a desired DO set point through the HMI. Based on a 4-20 mA signal from DO probes installed in the ICEAS basins, blower speed is controlled by the PLC to maintain the desired DO level in the tank. If the blower is running at its lowest speed and the DO level exceeds +0.5 mg/l above the set point for a predetermined amount of time, the blower will shut down. When the DO level drops to –0.5 mg/l below the set point, the blower will restart.

CENTRIFUGAL BLOWERS WITH INLET VALVE: WITH DO CONTROL

When using centrifugal blowers for DO control, an automatic modulating inlet valve is required to control the blower output. The operator enters the desired set point at the HMI. The blower inlet mechanism is then adjusted to maintain the set point. If the blower is running at its lowest speed and the DO level exceeds +0.5 mg/l above the set point for a predetermined amount of time, the blower will shut down. When the DO level drops to –0.5 mg/l below the set point, the blower will restart.

AERATION SYSTEM OPERATION

Aeration is applied to the ICEAS basins for a pre-determined amount of time during each cycle. Typically, air is cycled back and forth between two basins via automatic air control valves. The two basins will never require air at the same time. In this way, a single duty blower can serve both basins.

To optimize system efficiency, it is sometimes necessary to reduce the amount or duration of airflow to the basins. Various strategies of DO control were previously discussed.

Both the SANITAIRE Fine Bubble Membrane and Stainless Steel Coarse Bubble diffusers are designed to accommodate both on/off operation and a wide range of airflows.

AIR CONTROL VALVE OPERATION

The typical two-basin ICEAS process is designed such that only one basin receives air at a time. Essentially, one blower operates continuously while air is cycled back and forth between basins through the use of automatic air control valves.

In the sequence of air control valve operation, the valve to the basin, which is about to receive air, opens prior to closing the valve to the basin in the aeration phase. This reduces the number of blower starts. If the system is designed with only one tank, automatic air control valves are not necessary. The air control valves are fully integrated with process control time overrides and interlocks, thereby eliminating the potential for blower activation during decant.

WASTE SLUDGE PUMP OPERATION

The ICEAS process is dependent upon a healthy microorganism population, which means that sludge needs to be wasted regularly. The plant operator must monitor the MLSS level in the basin in conjunction with the system sludge age and adjust the waste sludge pump run time accordingly. Sludge is typically wasted during the decant phase of the cycle to take advantage of maximum solids concentration.

The HMI panel allows the operator to set the waste sludge pump start time and run time.