



## Dairy Industry



- Background**
- At Linde, we are making our planet more productive. The industrial gases that are used in the dairy industry allow facilities to reliably meet their wastewater treatment guidelines. Linde's goal is to help companies improve their productivity.
  - The dairy industry undertakes a number of activities that involve converting raw milk into milk, butter, cheese and yogurt using processes such as chilling, pasteurization, and homogenization.
  - Dairy raw wastewater is characterized by high concentrations of organic matter and nutrients. Dairy wastewater systems tend to have fluctuating loads due to the discontinuous nature of the production process in dairy processing. Dairy wastewater facilities are faced with a number of challenges in their operations, which could include:

### pH Reduction with CO<sub>2</sub>

**Challenge.** Dairy wastewater can have a wide range of pH values. Fluctuation of wastewater pH (3.0 to 10.0) is a consequence of the cleaning of production equipment using alkaline and acidic cleaning agents. Some facilities manufacture dairy derived acids that contribute to low pH values. Dairy wastewater might contain acids, alkali, detergents, disinfectants and quaternary ammonia compounds. Mineral acids are traditionally used in the equalization tank for pH control.

**Linde Approach.** Linde's CO<sub>2</sub> application for pH control allows facilities to effectively neutralize alkali wastewaters. Handling CO<sub>2</sub> is easier and less hazardous than the handling requirements of mineral acids. Carbon dioxide does not require spill protection or corrosion resistant piping. Carbon dioxide also eliminates the possibility of over treating because CO<sub>2</sub>-water equilibrium conditions ensure that pH levels do not drop below 6.5.

### Capacity increase with pure oxygen aeration

**Challenge.** Due to increases in production or changes in the product line, dairies often reach a point where their on-site wastewater treatment or pretreatment plant cannot treat all of the wastewater from the facility, which may result in odors or may require shipping wastes off-site for treatment. Expanding the treatment facility requires a large capital investment, occupies a substantial footprint and drains plant personnel resources.

**Linde Approach:** A retrofit with pure oxygen aeration can increase the capacity of the wastewater plant with a minimal capital investment and without increasing the footprint of the wastewater treatment facility. Linde offers comprehensive pure-oxygen aeration solutions, including oxygen supply systems, control systems and dissolution equipment.

## Removal of Fats, Oil, Grease and Suspended Solids Loads

**Challenge.** Large amounts of water are used during the dairy process, resulting in about 0.2-10 L of wastewater per liter of processed milk. These wastewater streams may contain fats, oil and greases (FOGs), phosphorus, suspended solids (TSS) and heavy metals. Flocculation and coagulation are used to remove these contaminants. The amount of coagulant and flocculent that is used and the effectiveness of this process are dependent on the pH and alkalinity of the wastewater.

**Linde Approach.** Linde's CO<sub>2</sub> application enables more accurate control of pH during physico-chemical treatment. In some facilities, solids and FOGs removal is achieved using dissolved gas flotation systems where inert gases like nitrogen (N<sub>2</sub>) can be used.

## High Strength Organic Loads

**Challenge:** Due to the presence of milk solids (e.g. protein, fat and carbohydrates like lactose) untreated wastewater from dairy processing facilities has significant organic content. The biochemical oxygen demand (BOD) of dairy wastewater can range from about 0.8 to 2.5 kilograms per metric ton (kg/t) of milk in the untreated effluent. The chemical oxygen demand (COD), is normally about 1.5 times the BOD level and ranges from about 1.2 to 3.8 kilograms of COD per metric ton (kg/t) of milk.



**Linde Approach:** High purity oxygen systems enable wastewater facilities to treat a higher organic load, typically double or more, than what can be treated by a conventional air based system. With our efficient and proven oxygenation systems, mixing and oxygen transfer is decoupled. Providing enough oxygen to meet an increased organic load is as simple as turning up an oxygen supply valve to feed more oxygen to the wastewater process.

## High Nitrogen Loads

**Challenge:** Dairy wastewater contains milk based substances that include ammonium (from the amino acids) and ammonia nitrogen (TKN) as well as residual cleaning agents such as detergents. The concentration of nitrogen nutrients could be around 20-800 mg/l total nitrogen.

**Linde Approach:** Pure oxygen devices offer an integral solution for reducing organic matter and nitrogen. By allowing for effective nitrification and denitrification, we provide a comprehensive solution for allowing dairy facilities to meet their treatment goals. Using intermittent oxygenation, we enable facilities to utilize a single basin to achieve nitrification and denitrification. The solution is very flexible to changes in flow and composition.

## Odors

**Challenge:** Odors in and around milk processing plants come from the biological decomposition of milk derived organic matter, generally found in wastewater.

**Linde Approach:** Using high purity oxygen and delivery systems from Linde helps to ensure that sufficient oxygen is provided in the main aeration basins. This helps to prevent septic conditions from occurring that would result in odor production.

- Conclusion**
- Whether your wastewater treatment system is an extensive aerated lagoon, or a compact wastewater process, our technology offerings will provide you with effective and reliable treatment.
  - Linde's tested and proven wastewater offerings have been deployed in dairy wastewater treatment facilities.
  - Call us today to discuss your particular wastewater treatment process needs and let us help you improve your productivity.

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