FujiClean USA™ LLC
Toward Clean Water…

Fuji Clean Cold Weather and High Altitude Performance

The question has arisen as to how well a Fuji Clean CE- or CEN-Series unit will perform at high-altitude locations during winter. New Mexico regulators want to know if specific studies have been conducted to confirm performance. Special studies are unnecessary as will be explained below.

Winter-time Performance.

Fuji Clean products—as are all biological wastewater treatment—are affected by temperature. The biota reproduce more slowly at lower temperatures. It is for this reason that Fuji Clean recommends that its tanks be insulated at locations subject to freezing temperatures and little snow cover. This insulation provides an additional layer protection to that already provided by the inherent design and operation of the system itself. We anticipate that the average wintertime water temperature inside a Fuji Clean unit will be at least 65°F. Consider the following:

Ground Temperature. The bottom of a Fuji Clean tank will be buried approximately seven feet below the ground surface. Frost penetration is conservatively estimated to be 27 inches. The Fuji Clean unit will be approximately 55° F, which is typical. The surrounding ground acts as a "sink" to draw heat from the tank but also limits minimum temperature inside the tank.

Please note that snow cover is often significant at higher elevations. Snow is an excellent insulator and by itself protects Fuji Clean units from becoming too cool.

Influent Wastewater Temperature. Wastewater exiting a dwelling will have been conditioned such that its temperature is at or above the temperature inside the dwelling. A typical dwelling is heated to about 68°F, and hot water can range to approximately 140°F, so wastewater inside the first Fuji Clean chamber will have a typical temperature of approximately 80°F as influent mixes as it enters the unit.

Compressor. The Fuji Clean compressor is most overlooked source of heat. Recall that air temperature is related to its density, so a typical compressor will discharge air having a temperature approximately 75°F warmer than its inlet temperature. A Fuji Clean unit uses an 80 L/min compressor, so aeration chamber is constantly being warmed as it is aerated. The continuing warming from the compressor balances the continuing cooling from the surrounding ground, the result being a near constant temperature year round.

Fuji Clean units experience an annual internal temperature change of approximately 20°F, the difference resulting from changes in ambient air temperature and hours of sunshine. Insulation, near-constant ground temperatures, and influent mixing all moderate the temperature changes. Low ambient temperature have minimal effect on Fuji Clean treatment efficiency.

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High Altitude Performance

Fuji Clean units incorporate highly efficient aeration systems. The aeration system includes a 100 L/min (nominal) "linear" compressor, tubing, and mixing system. The result is that aeration chamber water is routinely at or near oxygen saturation regardless of wastewater strength and/or elevation based on a conservative ten percent oxygen transfer efficiency. .

Santa Fe provides a convenient example. The city resides at an elevation of 7,200 ft, which is approximately 2200 m. Using the "International Standard Atmosphere" chart, the observed air density and air pressure will be about 81 percent and 78 percent, respectively, of sea level. In effect, the 80 L/min compressor will deliver the equivalent of about 60 L/min compared to sea level.

A Fuji Clean CEN5 aerator produces 80 L/min. Using standard air density and ten percent efficiency, the compressor will deliver approximately 3.4 kg of oxygen into the wastewater. The maximum carbonaceous and nitrogenous oxygen demand under ANSI/NSF Standard 40 (350 mg/L BOD and 80 mg/L TN), however, will be only about 1.34 kg, resulting in a factor of safety of 2.53. In Santa Fe, the aerator will provide only about 3.3 kg of oxygen. The reduction still provides a factor of safety of 1.97. Were New Mexico regulators comfortable with maintaining a minimum 1.25 factor of safety, aerators could be upsized as follows by 20 percent for an elevation above 10,000 feet, as shown below.

Blower Capacity vs Altitude		
	Aerator Size (L/min)	
Model	**0-10,000 ft**	**> 10,000 ft**
CE5/CEN5	80	100
CE7/CEN7	80	100
CE9/CEN9	100	120

Summary

Fuji Clean systems have over 40 years of continuous, successful operation in over two million installations. The concerns regarding high altitude and low temperature performance are addressed through detailed installation instructions—including insulation—and robust aeration system design. Fuji Clean stands behind its products and has full confidence that Fuji Clean units installed in New Mexico will meet all performance expectations when the units are designed, installed, operated, and maintained in accordance with Fuji Clean recommendations, requirements, and prohibitions.