

Continuous-Flow Bench-Scale Ozone System

The information required to develop design criteria for ozone facilities includes ozone demand, ozone decay, and screening of ozone application points. Traditionally, this information has been developed using pilot-scale facilities, semi-batch bench-scale testing units, or modeling techniques. The major drawbacks of ozonation pilot studies include the tendency to overestimate the hydraulic efficiency and the high cost and time commitment required to mobilize the equipment. Semi-batch reactors and the use of mathematical models do not

Carollo's bench-scale ozone system offers the following benefits:

- ▼ Provides data representative of full-scale ozone systems.
- ▼ Determines key design parameters using a 5-gallon sample.
- ▼ Offers quick mobilization (half day) to allow ozone treatment options to be evaluated for transient water quality episodes.
- ▼ Easily simulates a wide range of water quality and operating conditions.

provide sufficiently reliable data for extrapolation to full-scale design. To address these drawbacks, Carollo has developed a continuous-flow bench-scale ozone testing unit which combines the reliability of pilot-scale testing and cost-effectiveness of bench-scale methods.

Carollo's bench-scale unit consists of a six-stage ozone contactor with

three chambers operating in counter-current flow for ozone transfer and three chambers operating without gas transfer for ozone contacting. The volume of each chamber available for ozone contacting is adjustable to achieve detention times ranging from 3 to 40 minutes. The ozone concentration in the feed gas is monitored by an ultraviolet (UV) light absorption spectrophotometer. Ozone residuals in the liquid phase are analyzed by collecting grab samples at the effluent of each of the columns.

System Hydraulics

In order to ensure the applicability of the results, we have designed this system so that the hydraulics are characterized with a T_{10}/T ratio of 0.6 to 0.7. This hydraulic behavior is modeled by seven to nine completely stirred tank reactors (CSTR) in series,

corresponding to Peccet numbers of 12 to 16, respectively. This hydraulic characteristic is maintained in Carollo's pilot-scale ozone systems.

Ease of Mobilization

The ozone system resides in a shipping container for easy transport to various sites for ozone testing. Associated equipment includes ozone contactors, rotameters for measuring liquid and gas flow rates, valves and tubing, and sample taps. This unit also includes a 0.08 lb/day ozone generator. Other equipment required to perform ozone evaluations, such as a feed water pump, UV spectrophotometer, and ozone residual measurement kit, is shipped with the system.

Mobilization and testing can begin within a half-day of arrival on-site. Only a small sample volume (approximately 5 gallons) is required in order to develop key design data such as ozone demand and decay relationships, by-product formation, and ozone quenching alternatives.



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Design Criteria		
	Value	Additional Information
Hydraulic Detention Time Range	3 to 40 min	
Ozone Transfer Columns		
Type	-	2 in diameter, 18 in height
Number	3	
Ozone Transfer	-	Fine bubble diffusion with glass frit
Hydraulic Condition (CSTRs, in series)	6 to 8	
Ozone Contact Columns		
Type	-	½ in diameter, 7 in height, no ozone transfer
Number	3	
Ozone Generation		
Number	1	
Capacity	0.08 lb/day	
Ozone Dose Range	0.1 to 20 mg/L	

Technical Specifications	
Shipping Container Weight	100 lbs
Shipping Container Dimensions (L x W x H)	36 in x 24 in x 24 in
Electrical Requirements	Single phase, 60 Hz, 120-Volt
Typical Rental Fee	\$600 per day