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Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment

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Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment

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ABSTRACT

Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment provides several techniques and guidance for use in developing quality assurance requirements for specifying fine-pore aeration equipment. Three methods for specifying compliance testing are outlined. Two are based on conducting oxygen transfer shop tests and the third is based on conducting full-scale oxygen transfer testing. The basis for compliance testing includes oxygen transfer testing of selected individual diffusers or two reference tests—dynamic wet pressure and effective flux ratio. A description of test procedures and diffuser sampling is provided.

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STANDARDS

In April 1980, the Board of Direction approved ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by the Society. All such standards are developed by a consensus standards process managed by the Management Group F (MGF), Codes and Standards. The consensus process includes balloting by the balanced standards committee made up of Society members and nonmembers, balloting by the membership of ASCE as a whole, and balloting by the public. All standards are updated or reaffirmed by the same process at intervals not exceeding 5 years.

The following Standards have been issued:

ANSI/ASCE 1-82 N-725 Guideline for Design and Analysis of Nuclear Safety Related Earth Structures

ANSI/ASCE 2-91 Measurement of Oxygen Transfer in Clean Water

ANSI/ASCE 3-91 Standard for the Structural Design of Composite Slabs and ANSI/ASCE 9-91 Standard Practice for the Construction and Inspection of Composite Slabs

ASCE 4-98 Seismic Analysis of Safety-Related Nuclear Structures

Building Code Requirements for Masonry Structures (ACI 530-99/ASCE 5-99/TMS 402-99) and Specifications for Masonry Structures (ACI 530.1-99/ASCE 6-99/TMS 602-99)

ASCE 7-98 Minimum Design Loads for Buildings and Other Structures

ANSI/ASCE 8-90 Standard Specification for the Design of Cold-Formed Stainless Steel Structural Members

ANSI/ASCE 9-91 listed with ASCE 3-91

ASCE 10-97 Design of Latticed Steel Transmission Structures

SEI/ASCE 11-99 Guideline for Structural Condition Assessment of Existing Buildings

ANSI/ASCE 12-91 Guideline for the Design of Urban Subsurface Drainage

ASCE 13-93 Standard Guidelines for Installation of Urban Subsurface Drainage

ASCE 14-93 Standard Guidelines for Operation and Maintenance of Urban Subsurface Drainage

ASCE 15-98 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)

ASCE 16-95 Standard for Load and Resistance Factor Design (LRFD) of Engineered Wood Construction

ASCE 17-96 Air-Supported Structures

ASCE 18-96 Standard Guidelines for In-Process Oxygen Transfer Testing

ASCE 19-96 Structural Applications of Steel Cables for Buildings

ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations

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ASCE 21-98 Automated People Mover Standards—Part 2

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SEI/ASCE 24-98 Flood Resistant Design and Construction

ASCE 25-97 Earthquake-Actuated Automatic Gas Shut-Off Devices

ASCE 26-97 Standard Practice for Design of Buried Precast Concrete Box Sections

ASCE 27-00 Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction

ASCE 28-00 Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction

EWRI/ASCE 33-01 Comprehensive Transboundary International Water Quality Management Agreement

EWRI/ASCE 34-01 Standard Guidelines for Artificial Recharge of Ground Water

EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment

CE/ASCE 36-01 Standard Construction Guidelines for Microtunneling

FOREWORD

The methods described in these standard guidelines provide several techniques for developing quality assurance requirements for specifying fine-pore aeration equipment. The guidelines are for the practice of quality assurance to control the quality of the product provided to a user at a specified acceptable level. Quality assurance benefits all parties involved in the manufacturing, specification, and use of aeration equipment. For the manufacturer, standardized quality assurance should reduce the number of indefinite or unrealistic specifications, enhance the probability of achieving unequivocal specifications, and improve the understanding between supplier and user. For the designer and owner/user, confidence will be substantially improved that the performance of the aeration equipment at start-up will meet the design criteria. For the industry as a whole, application of consensus quality assurance methods is likely to result in improved quality and reliability and more favorable life-cycle costs.

The procedures for dynamic wet pressure and effective flux ratio outlined in these guidelines for fine-pore diffusers have been used by a handful of engineers over the past 5 years. The data collected to date indicate that these procedures provide the engineer, owner, and manufacturer with some degree of confidence in the quality of the diffusers delivered at the site at a reasonable cost. The correlation shown in Appendix C is based on only a few installations. A more extensive database is required to better specify ranges of these parameters in quality control tests. These guidelines are a first step in the process of improving quality assurance of fine-pore diffusers.

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Guidelines For Quality Assurance of Installed Fine-Pore Aeration Equipment

1.0 Scope

The methods described under these standard guidelines provide several techniques for use in developing quality assurance requirements for specifying fine-pore aeration equipment. The guidelines are for the practice of quality assurance. Quality assurance is practiced by users to control the quality of the product provided to a user at a specified acceptable level. In contrast to quality assurance, quality control is practiced by manufacturers to control the quality of production at a specified acceptable level.

Although quality assurance and quality control practices can be considered as independent activities, their goals are essentially the same: to ensure that the consumer receives quality equipment on time for the contracted price.

Quality assurance benefits all parties involved in the manufacture, specification, and use of aeration equipment. For the manufacturer, standardized quality assurance should reduce the number of indefinite or unrealistic specifications and enhance the probability of achieving unequivocal specifications and improved understanding between supplier and user. For the designer and the owner/user, confidence that the performance of the aeration equipment at start-up meets the design performance criteria will be substantially improved. For the industry as a whole, application of consensus quality assurance methods is likely to result in improved quality and reliability and more favorable life cycle costs.

The designer and owner/user must consider the costs associated with quality assurance testing when developing and specifying quality assurance testing requirements. The testing requirements should be discussed with the manufacturers to ensure that the project objectives are achieved.

2.0 Summary of Method

Aeration systems are designed to meet project-specific needs that dictate the size and sometimes the configuration of the aeration basins. Selection of aeration equipment is based on previous experience of the designer, performance data provided by equipment manufacturers, and other published data. The project is then open for bids, and any equipment manufacturer who can meet the specified requirements may be selected to provide the aeration system for the project. To show that the performance criteria are achieved, compliance testing can be specified as a condition of acceptance.

2.1 Performance Parameters

The two process-related parameters frequently used to specify performance of fine-pore diffusers are oxygen transfer efficiency (OTE) and pressure required for the air diffusion system to operate. These two parameters are used because they determine how much air must be compressed and to what pressure, which in turn determines the cost of operation. One underlying assumption is that the installed system is mechanically sound.

2.1.1 Oxygen Transfer Efficiency

OTE can be expressed in a number of ways. The definitions that follow are taken from the ASCE publication, *A Standard for the Measurement of Oxygen Transfer in Clean Water.*[1]

Oxygen Transfer Rate (OTR)—mass of oxygen dissolved per unit time in a volume of water by an oxygen transfer system operating under given conditions of temperature, barometric pressure, power, gas rate, and dissolved oxygen (DO) concentration.

Standard Oxygen Transfer Rate (SOTR)—OTR in clean water when the DO concentration is zero at all points in the water volume, the water temperature is 20°C, and the barometric pressure is 1.0 atmosphere.

Aeration Efficiency (AE)—OTR per unit total power input. Power input may be based on either delivered power or wire power, and this basis must be stated.

Standard Aeration Efficiency (SAE)—SOTR per unit total power input. Power input may be based on either delivered power or wire power, and this basis must be stated.

Oxygen Transfer Efficiency (OTE)—fraction of oxygen in the injected gas stream dissolved under given conditions of temperature, barometric pressure, gas rate, and DO concentration.

Standard Oxygen Transfer Efficiency (SOTE)—OTE in clean water when the DO concentration is zero at all points in the water volume, the water temperature is 20°C, and the barometric pressure is 1.0 atmosphere.

2.1.2 Operating Pressure

The pressure required to operate the system is the sum of the piping losses, the hydrostatic pressure over the diffusers, the losses in the submerged piping, the pressure decrease across any flow-control orifices, and the pressure decrease across the diffusion medium itself. Because the equipment manufacturer is typically