

Primary Treatment in Decentralized Wastewater Systems: Research Considerations

Septic tanks and **grease traps** are mechanically simple and efficient primary treatment units of critical importance in decentralized wastewater systems. However, their function is relatively complex (e.g., settling and digestion co-occur) and performance is likely affected by numerous factors, of which relatively few have been assessed in a level of detail sufficient to definitively influence design or operation.

The design, construction, installation, and maintenance of primary treatment units in the U.S. are driven primarily by **prescriptive standards** based on limited and often dated scientific information. Codification of standard designs into prescriptive regulations has restricted the continued development of design improvements.

Nevertheless, in many cases, septic tanks—particularly those serving domestic sources of wastewater—perform their dual functions of settling and digestion quite well. As such, future research efforts should be directed toward answering outstanding questions whose results are likely to yield real improvements in design and operation within the context of overall onsite wastewater system performance. A **comprehensive research strategy** and agenda should be developed to determine which research questions are worthy of further study relative to costs/benefits and risk management.

Research Tools

The following resources are available at www.werf.org and www.ndwrcdp.org:

- Research Digest: Factors Affecting the Performance of Primary Treatment in Decentralized Wastewater Systems
- Bibliographic Database of Research and Data on Performance of Primary Treatment Units in Decentralized Wastewater Systems

Suggested Research Priority Areas

Overall System Performance, Performance as a Function of Wastewater Characteristics, and Oversight and Operation

Overall System Performance

- Assess the field performance of effluent screens/filters and the impacts of design parameters on septic tank and grease trap performance
- Evaluate seasonal and regional differences in unit function to optimize design and O&M requirements
- Evaluate inlet and intercompartment transfer devices to optimize existing septic tank designs
- Develop and calibrate Computational Fluid Dynamics models and use them along with hydraulic investigations (e.g., flow dispersion studies) to inform future studies and designs
- Assess applicability of alternative septic tank designs (meander, UASB-septic, and Imhoff tanks) relative to flow patterns and compartment orientation
- Evaluate grease trap performance relative to sizing and design modifications, considering food service characteristics which are likely to be influential
- Evaluate the viability of energy recovery (e.g., biogas collection)

Performance as a Function of Wastewater Characteristics

- Develop scientifically based design criteria for cluster and especially non-residential/industrial onsite wastewater systems
- Assess the field impacts of water softeners on septic tank performance
- Develop and validate standard protocols for testing the safety and fate of household chemicals
- Generate paired influent and effluent dataset for evaluating performance of in-service tanks in various field applications
- Evaluate the fate, occurrence, and treatability of priority pollutants and contaminants of emerging concern

Oversight and Operation

- Develop a model program for tank construction and installation quality assurance and quality control (QA/QC)
- Improve understanding of the evolution and maturation of biological functions to inform design and operational practices
- Develop and validate standard methods for sampling and monitoring septic tank performance, including sludge/scum measurement techniques
- Develop improved methods for assessing septage biology and diagnosing performance problems
- Provide a mechanism for industry to evaluate the actual impacts and effectiveness of tank additives
- Develop and establish the validity of field sites for testing septic tanks and grease traps
- Determine relationship between regulations on construction, installation, and inspection and failure rates

Other Research Recommendations

- *Studies have historically been conducted with too many variables or limited statistical power, making it impossible to isolate the effects of individual variables on performance, thus yielding little useful information. Future studies should set clear, realistic research objectives that can be accomplished with available resources.*
- *Future studies should carefully consider the applicability of the three main types represented in the existing body of research: laboratory-scale studies, controlled pilot testing, and field surveys. Many studies have historically utilized controlled pilot testing which may not adequately simulate field performance.*
- *What information is available in the decentralized wastewater field could be better managed and distributed. The industry should develop tools that will allow future (and perhaps existing) monitoring data to be banked collectively. However, it is recommended that the focus of future work be on using available resources to conduct original research, focusing on statistically robust experimental designs.*

WERF Project 04-DEC-7

Principal Investigator

Victor D'Amato, PE, ARCADIS U.S., Inc.

Communications Consultant

Anita Bahe, Ph.D., Lynx Group International