25 YEARS OF WASTEWATER DRIP DISPERSAL

1993-2018

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ABSTRACT

This paper is a review of the applied sciences of onsite wastewater as they relate to Drip Distribution and related research papers affirming the application of drip technology in soils for Advanced treatment and Nutrient removal. Authors such as Dick Otis, Bob Rubin, Jim Converse, John Buchannan, Bob Siegrist, Jerry Tyler, and many other notable researchers have evaluated drip distribution and added their expertise in a variety of subject matters to enhance the industries understanding of the effectiveness of wastewater drip technology. Research results showing enhance treatment and nutrient removal significantly better than traditional technologies are presented. Mathematical models that have been developed to predict treatment and nutrient removal levels are also presented.

WASTEWATER DRIP DEVELOPMANT

Wastewater Drip dispersal was first introduced to a broad audience of practitioners during training at the North Carolina State Extension “Operators training school” in the early 1990’s. Tom Sinclair of “Wastewater Systems Inc.”, of Georgia got the interest of Dr. Bob Rubin, of NC State and soon of Dr. Dick Otis, an EPA consultant.

Dick Otis of Ayers Associates as a consultant to the EPA did research on the sustainability of onsite wastewater systems. In his early 1990’s paper, titled “Soil Clogging: Mechanisms and Control”, covering a review of 25 referenced papers ranging from the year 1947 to 1984. Dr. Otis outlined both the best practices we knew at that time and the areas that need more research. Long narrow trenches, shallow installations, aeration and the uniform, intermittent application of wastewater on soil predicted the benefits of drip distribution used in wastewater application.

Rubin and Otis, facilitated by Tom Sinclair, dug up many systems in Georgia for evaluation. The results of this evaluation were presented in a report to Sinclair in 1994, “Evaluation of Hydraulic Loading Criteria for the "Perc-Rite®" Subsurface Drip Irrigations Systems”.

Sinclair developed a system package called "Perc-Rite®" and received patent number 5,200,065 and approvals in Georgia and North Carolina. From then until now there has been two major drip tubing manufacturers competing for the US market, “Geoflow” and “Netafim.” Neither tubing manufacturers assembles complete equipment packages to handle wastewater applications to make their tubing sustainable, so Sinclair and others packaged and sold the necessary equipment and started soliciting state approvals. Sinclair licensed American Manufacturing Company, Inc. of Virginia to manufacture under the “065” patent in 1993.

American Manufacturing followed Sinclair’s approvals for residential application with a proprietary approval in North Carolina in 1993 and a Waiver of experimental in Virginia in 1995.

In 1999, under the guidance of Otis and other professionals schooled in the art, NOWRA took the step to sponsor several “Drip Summits”. Manufacturers and industry professional together reviewed the state of the art and developed a Drip standard that was adopted by NOWRA in 2005, (NOWRA.ORG) “Recommended Guidance for the Design of Wastewater Drip Dispersal Systems”. This multi-year process produced the first consensus document that defined key elements for successful design, installation, and operation of a drip system.

The NOWRA Drip Summits brought a wide range of professionals together to develop consensus understanding of how drip works and best design practices for the technology. Participating practitioners agreed that elements similar to what are in the existing plumbing code should be included when specifying drip, such as manufacturers certifying tubing to be usable in wastewater as with all other components.

Understanding of water movement through soil is important since the early research on drain field always worked with a two-dimensional gravel-soil interface. With Drip, the tubing is installed directly in the soil so the water will move in all directions. This is what makes drip so much different than other pressure distribution technologies.

At the same time many academics throughout the nation spent time researching many different elements of how the “drip technology” was useful in wastewater applications.

SUPPORTING RESEARCH

1994 - Duncan, C.S, R.B Reneau, Jr., Hagedorn 1994, Impact of effluent quality and soil depth on renovation of domestic wastewater in onsite wastewater treatment Proc. Of the Seventh National Symposium on Individual and Small Community Sewage Systems. ASAE, St Joseph, Mi pp219-228. This study supports the contention that treated effluent can be loaded on soil at a higher rate than septic effluent. The significant element of this study is that soil columns were dosed 6 times a day and showed that less than 1’ of soil provided suitable treatment. This dosing regime, however, can only be achieved with drip technology.

2000 - Larry Hepner 1997-1999, Delaware Valley College, in-situ study of 6 technologies for on-lot systems. “New Wastewater Technologies for Pennsylvania,” On-Lot Systems and Small Flows. Technology E provided research proving drip for Pa. is a viable alternative for onsite wastewater infrastructure. In the third year of this 5-year study, the researchers in

Pennsylvania recommended that the Drip Technology be approved for the benefit of the citizens and mainstreamed for use across the Commonwealth. The research on drip did continue with the focus on Septic effluent as opposed to secondary treated effluent that was the focus of this first study.

ASABE Publication Date 20 October 2007. L.D. Hepner, D. Linde, C. Weber, D. Smith. "Reduction of Bacteriologic and Chemical Constituents of Septic Tank Effluent with Depth using a Drip Dispersal System." This study was the follow up to the study using treated effluent.

Abstract. "The ability of a moderately well drained soil to treat septic tank wastewater at depths of 1,2,3, and 4 feet beneath the surface was evaluated using drip dispersal technology. Three drip dispersal systems of 1200 feet of tubing each were dosed with 400 gpd septic tank treated wastewater (loading rat of 0.17 gpd/ft2). Zero tension lysimeters were installed at 1,2,3, and 4feet beneath of the surface to capture gravity water moving through the soil. Samples were analyzed for Fecal Coliform, Fecal Strep, BOD5, NY3-N, NO3-N, and soluble P. Median value reductions of 99% for Fecal Coliform, 99% for Fecal Strep, 86% for BOD5, 85% for NH3-N + NO3-N and 90% Soluble P were obtained at the 1-foot lysimeters. Based on these trials 1 foot of Aerobic soil appeared to provide significant treatment of septic tank wastewater when loaded at 0.17 gpd/ft2 with a landscape linear load of approximately 6 gpd/LF."

Hepner guided this study that included statistician support from college staff. The statistical analysis showed no statistical difference between the application of secondary and septic effluent in the soil.

1999 Converse, Bohrer – "Soil Treatment Performance and Cold Weather Operations of Drip Distribution System." Five drip distribution systems in Wisconsin were monitored to evaluate the performance of these systems in cold weather" Temperatures were monitored during the winter from 1998-2000. Despite two relatively mild winters in Wisconsin during this period many below freezing temperatures were recorded and no operational problems were experienced. The authors concluded; "With proper design and installation, drip distribution systems are an excellent alternative system for wastewater dispersal in cold climates."

2004 TVA and EPRI 2004 Wastewater Subsurface Drip Distribution," Peer Reviewed Guidelines for Design, Operation, and Maintenance", EPRI, Palo Alto, CA and Tennessee Valley Authority, Chattanooga, TN. Chapter 1-Purpose and Objective leads with the following: "Subsurface drip irrigation, or more appropriately for wastewater applications, subsurface drip distribution (SSD) is the most efficient method currently available for application and subsurface dispersal of wastewater to soil. Because it is so effective, drip distribution represents a viable option for wastewater disposal for all soil types." The booklet describes current best practices for design and prediction for nitrogen removal for both small and large flow systems.

2012 Heufelder, George, Barnstable Col Mass, Mass DEP, "Investigation of the treatment of Drip Dispersal Onsite Septic Systems for the Removal of Selected Micro -Constituents and Contaminants of concern". From the Executive Summary: "A preliminary investigation regarding the removal of selected Contaminants of Emerging Concern (CEC) by shallow soils-based onsite septic system technologies was conducted at the Massachusetts Alternative Septic System Test Center in 2010 – 2012. Untreated septic

tank effluent was applied to a shallow (less than 9 inches) soil horizon in lined test cells. We report that removal efficiencies of selected pharmaceuticals, hormones and personal care products in drip dispersal systems are generally higher than those levels reported for non-soils-based treatment technologies. The removal efficiencies of the selected compounds using drip dispersal reported approach 100%. The data suggest that septic systems employing shallow soils-based means for ultimate disposal may offer comparable to better treatment for certain micro-constituents of wastewater compared to some municipal wastewater treatment facilities. The fire retardant TCEP (Tris (2-chloroethyl) phosphate) was not attenuated during treatment and, similar to the conclusion reached in other studies, may prove to be a particular challenge for wastewater treatment removal strategies."

2014 Robert L. Siegrist **Water movement and fate of Nitrogen during drip dispersal of wastewater effluent into a semi-arid Landscape**, Presented at the Onsite Wastewater Conference, Soil Science Society of America, April 7-8, 2014, Albuquerque, NM. Robert L. Siegrist, Rebecca Parzen , Jill Tomaras, Kathryn S. Lowe a Civil and Environmental Engineering, Colorado School of Mines, Golden, CO 80401. Parzen (Colorado), by way of radio tagging of the STE nitrogen, as indicated and confirmed in Hydrus modeling, a majority of the effluent nitrogen applied by drip dispersal remained shallow in the soil proximate to the emitter and along the tubing.

August 2013, Tetra Tech, Inc, Recommendations of the On-Site Wastewater Treatment Systems Nitrogen Reduction Technology Expert Review Panel FINAL REPORT Submitted to: Wastewater Treatment Workgroup, Chesapeake Bay Partnership, August 2013 Prepared by: Tetra Tech, Inc., 10306 Eaton Place, Suite 340, Fairfax, VA 22030-2201. The report continued the study of drip as an appropriate BMP.

2018 EPA - Chesapeake Bay Program," Drip Irrigation and Peat Treatment System On-Site wastewater nutrient removal BMP Expert Panel Report". This report states concerning Septic Drip: "Based on the data analysis previously presented, the Panel concurs that a 50 percent net TN reduction for drip dispersal is warranted when the following conditions are met". Those condition include 7 points and 13 sub points that mirror what was developed 10 years earlier and adopted in the NOWRA drip guidance. The application rated recommended are:

The net 50 percent BMP credits will only be provided for systems using loading rates as applicable for STE, regardless of effluent quality. Maximum soil texture-based area loading rates are as follows; however, States can require the use of lower rates at their discretion: o TG II 0.27 gpd/sf o TG III 0.17 gpd/sf o TG IV 0.12 gpd/sf. The BMP for Drip Dispersal will be listed in the EPA protocols I late 2019.

2017 Robert L. Siegrist, Decentralized Water Reclamation Engineering, a curriculum workbook. Before his retirement, Siegrist wrote this curriculum workbook and included 120 pages of discussion on drip dispersal providing guidance for future engineers. American Manufacturing Company Inc. was a reviewer of the book.

Additional supporting and technical information may be viewed at:

www.americanonsite.com > Resources > Research articles and papers

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