TECHNOLOGY SMART APPROACH TO KEEP DRIP IRRIGATION SYSTEMS FUNCTIONAL

Reinders Felix B¹, Van Niekerk Adriaan S²

ABSTRACT

The world’s population is projected to reach 8.5 billion by 2030, 9.7 billion by 2050 and as water stress spreads around the globe, finding ways of getting more crop per drop to meet our food needs is among the most urgent of challenges. The first answer to this call is drip irrigation, which delivers water directly to the roots of plants in just the right amounts. It can double or triple water productivity – boosting crop per drop – and it appears to be taking off worldwide. Over the last thirty years, the area under drip and other “micro” irrigation methods have risen by more than 1000%, from 1, 03 million hectares in 1986 to more than 11 million hectares at present.

Innovative technology that uses ultrasonic sound to clean drip pipes was developed to embrace the efficiencies offered by drip irrigation in order to preserve precious water resources and to get a return on the investment. The technology known as Greendrum technology use only sound for cleaning and maintenance of drip irrigation pipes. It uses ultrasonic sound in a small body of water to effectively and quickly clean drip irrigation lines and pipes with ease. It is environmentally friendly and does not use any chemicals. There are a mobile unit and a stationary unit with three model sizes. All work on the same principle and the operation of the Greendrum machine is explained with the aid of figure 1.

![Figure 1: The Greendrum dripper line cleaning machine](image)

Testing has been conducted on the Greendrum technology to determine the effectiveness of the ultrasonic sound to clean the drippers. Through intensive

¹ Research Manager, ² Senior Researcher: Irrigation and Drainage Engineering, Institute for Agricultural Engineering, Agricultural Research Council, Private Bag X519, Silverton, 0127, Pretoria, South Africa. reindersf@arc.agric.za Phone: +27 (0)128424000
laboratory and field testing by the Agricultural Research Counsel’s- Institute for Agricultural Engineering (ARC-IAE), results were obtained and analysed that gave some insight into the performance of drip irrigation systems under field conditions and how effective the cleaning process of the Greendrum technology was.

The mobile Greendrum unit consists of two pulley systems with a stainless steel sound bath in between. Along and in the bottom of the sound bath (which is filled with water) is the ultra-sound source. The pulley system on the left in the picture is motorised and this pulls the drip line through the sound bath at a specific and constant speed. The speed determines the “contact time” of the drip line in the sound bath and it is set such that a contact time of about 20 seconds is achieved. The high frequency sound causes oscillation of the water and dirt particles which causes micro areas of negative pressure, which when upheaved, has the same effect as cavitation in pumps and this loosens the dirt particles. This system is also connected to a pump that circulates water through the dripper lines during the cleaning process and the flow rate are high enough to wash out the loosened dirt at the far end of the drip line. The cleaning process of the machine cleans the dripper lines internally as well as externally.

Drip irrigation is considered as the most efficient irrigation system, but there is proof from research and through testing that this system can also be in-efficient, due to clogging of emitters as a result of bad water quality, mismanagement and maintenance problems. There are four ways drippers can clog and it include the following:

- Silt (mud from dirty water)
- Bacteria and fungi (organic material)
- Chemicals (from using fertiliser)
- Metals (Iron and manganese)

Various approaches in preventing the clogging of emitters include filtration, flushing and chemical treatment of the irrigation water but they address mainly organic material. Ultrasonic sound on the other hand address all the clogging substances.

The new drip lines with emitters were tested under controlled conditions in the hydro laboratory of ARC-IAE for average discharge (\( \bar{q} \)) and for the manufacturing coefficient of discharge variation (\( CV_{q} \)). These values were used as a reference base in the evaluation of the experimental site and infield performance of the particular emitter types. Both \( \bar{q} \) and \( CV_{q} \) were determined for a total sample of 100 emitters, as well as for four groups of 25 emitters in accordance with the International Standards Organisation (ISO/TC 23/SC 18 N 89, 1983).

A complete system evaluation was done according to the procedure described in ASAE EP 458 (1997) where five dripper lines were evaluated at five positions. Apart from the \( \bar{q} \) and \( CV_{q} \), the statistical discharge uniformity (\( U_{s} \)) were also calculated.

For the evaluation of the Green drum machine, first the clogged drip line with one hundred drippers were mounted on the ARC-IAE dripper test bench to accurately measure the discharge of each individual dripper. After that, the drip line was fed into the Green drum cleaning machine and lastly the dripline was mounted with each dripper placed in the exact position on the test bench where it was measured before. Its discharge was then measured again at the same pressure as before. These measurements were processed to see what the effect was of the cleaning of the drip line by the machine.
With the testing there was a clear indication that drippers were clogging regardless of maintenance and treatment with chemicals. There was a tendency that the Emission Uniformity (EU) as measured in the field of all the dripper types, deteriorated over time from a new pipe EU of 92% to 87.1% in the first evaluation to 82.4% in the fourth and last evaluation one year later. With regard to the statistical discharge coefficient (Us), the drippers met in only 69% on average, the requirements.

Table 1 gives the results of driplines that were cleaned with the Green drum technology evaluations. The “before” is the result of the clogged dripline as retrieved from the field and the “after” is the result after it was cleaned with the ultrasonic sound.

**Table 1. Dripline results with the Green drum machine**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Number of clogged drippers</th>
<th>CV Value</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>%Change</td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Sample A</td>
<td>10</td>
<td>7</td>
<td>30</td>
<td>6,82</td>
<td>2,49</td>
</tr>
<tr>
<td>Sample B</td>
<td>11</td>
<td>6</td>
<td>45</td>
<td>10,57</td>
<td>2,85</td>
</tr>
<tr>
<td>Sample C</td>
<td>15</td>
<td>8</td>
<td>47</td>
<td>8,82</td>
<td>9,02</td>
</tr>
<tr>
<td>Sample D</td>
<td>22</td>
<td>4</td>
<td>82</td>
<td>12,92</td>
<td>7,76</td>
</tr>
</tbody>
</table>

*Note: A possible explanation for the fact that the CV got worse can be found in the fact that this is a pressure compensated dripper. These type of drippers are more susceptible to blocking and it is possible that dirt that was loosened by the cleaning process could have entered the drippers further down the line and this has caused “new” partial blockages.

With the Greendrum dripline cleaning machine the results showed that there was a 73% positive change in the Coefficient of variation (CV) of the dripper line from a bad CV of 10.57% to an excellent CV of 2.85%. As the drippers could not be cleaned in any other way, the Greendrum ultra-sonic sound way was extremely effective and totally recovered the drippers.

**REFERENCES**
