N E T A F I M U S A

HEAP LEACHING WITH DRIP

HIGHER PRODUCTION THROUGH SUPERIOR TECHNOLOGY

NETAFIM™

HEAP LEACHING WITH DRIP

Though much has been written about how to achieve higher ore extraction rates in heap leaching with drip, much of it is based on claims that are hard to prove and in some cases defy common sense. This paper describes how Netafim drip technology for heap leaching is reliable and provides the highest possible production. And we do it with straightforward facts!

WHAT WE ARE DOING

A heap leaching drip system simply takes the solution being delivered to the pad at a certain pressure and reduces that pressure to near zero as it flows through the emitter's labyrinth. In doing so the solution is evenly applied to the pad along the length of the dripline and across the zone.

DESIGNING FOR LONG-TERM PERFORMANCE

Since the emitters in the dripline reduce pressure in order to achieve the desired flow rate at a specified pressure, they have to perform at the same level over long periods of time, typically 24/7 for months on end.

To accomplish this, Netafim engineers know that there is an important trade-off that must be addressed when designing emitters - the labyrinth (flow path) needs to be as open as possible to allow potential debris to pass through, but as short as possible to lessen the area where clogging could occur. The engineers realize if the flow path is too long, or too narrow, the pressure may be reduced, but the emitter will ultimately clog with debris and stop dripping.

Like a meandering river, debris is more likely to settle when water moves slowly. Think of the 'muddy' Mississippi.

Conversely, fast-moving water is much less likely to allow settling and clogging to occur. Think Niagara Falls.

Name of the game - get through the maze

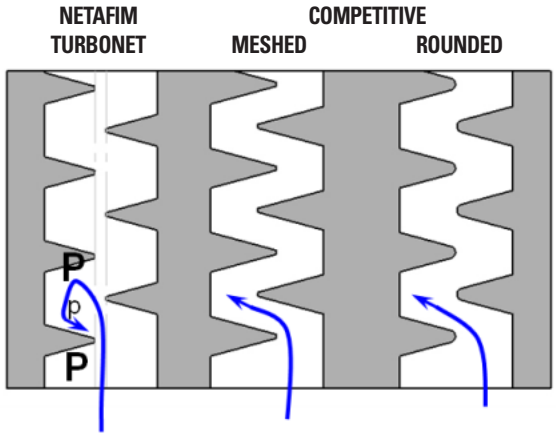
Fastest time wins!

HOW NETAFIM DOES IT

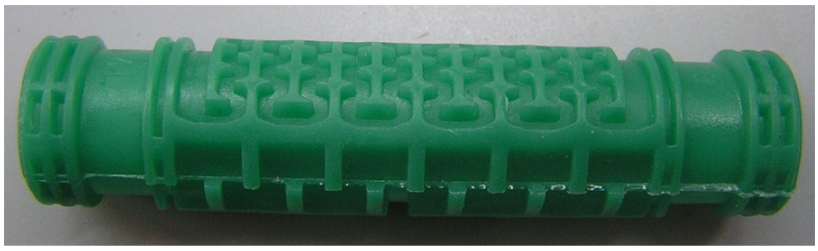
Netafim engineers have been designing a broad line of emitters since the 1960's that provide the shortest flow path and greatest debris resistance. In each of the emitters we design, the secret to our legendary performance is thanks to TurboNet™ technology.

TurboNet technology combines extremely sharp and defined teeth in the flow path with a straight-though passage for the flow. The combination of these two elements creates the capability of short flow path and reduced clogging.

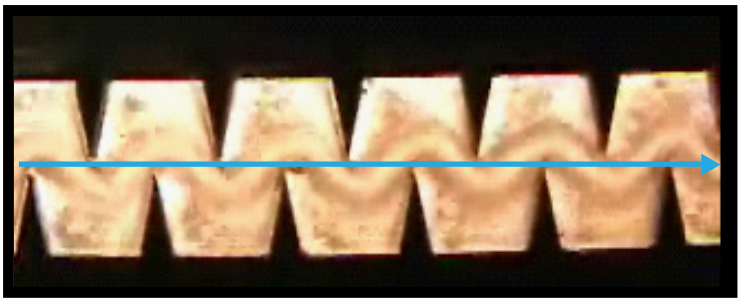
With TurboNet technology, debris stays suspended as it moves through the very short labyrinth due to the non-stop agitation of the solution. Said another way, flow is always fully turbulent! There are no areas where flow is laminar or transitional. This capability, not found in other styles of emitters dramatically decreases the chance that debris will get lodged because the velocity keeps impurities suspended.



Netafim's TurboNet labyrinth creates flow detachment and thus creates high velocities and strong turbulence. Meshed or rounded teeth actually reduce turbulence and lead to smaller flow path dimensions and more settling of debris. Note how the teeth of the Netafim emitter do not overlap in the center of the emitter as denoted by the light gray lines. This keeps turbulence high and the risk of clogging low.



This picture of a competitive cylindrical emitter illustrates the very long flow paths, lack of sharp, well-defined teeth, the laminar areas in the flow path and the burrs left behind in the molding process, each of which increases the potential of clogging.



Actual photo of water flowing through the labyrinth of a Netafim emitter with 'TurboNet' technology. Note the sharp teeth and how the blue arrow passes through the flow path without touching the sides.

HEAP LEACHING WITH DRIP

NETAFIM IS THE LEADER

To illustrate the clear advantage that Netafim has in flow path length, a competing manufacturer has published the following information in many of their publications. In it they show:

Total Length of Flow Path (linear inches):

- Netafim TurboNet™ - 2.54
- Their Emitter - 12.5

Because the shortest and most efficient flow path is critical, the proof is clear that Netafim is the leader.

ADDITIONAL WAYS NETAFIM DESIGNS FOR SUPERIOR PERFORMANCE

Netafim emitters have another characteristic not found in other styles of emitters - a large, square cross-section inside the emitter.

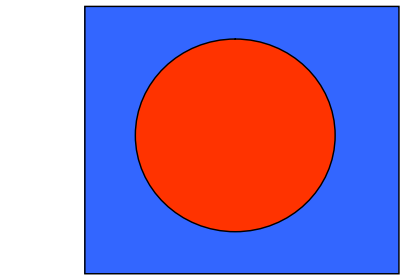
Finally, how the emitter is positioned in the tubing is very important. Because the velocity of a fluid moving along the inside wall of a pipe is reduced by friction, debris in the solution can settle. Because of this, keeping the filtration surface of the emitter away from the wall is very important.

Netafim emitters are designed so that their filtration surface is raised off the wall. In cylindrical emitters, the filtration surface is actually along the wall of the pipe where debris loading is greatest.

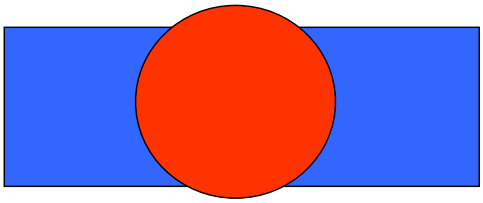
In short, clogging resistance depends on:

- Fully turbulent flow through the entire flow path
- Largest possible flow path cross-section
- Inlet filter raised off the wall of the pipe
- Shortest possible & most turbulent flow path

Score: Netafim - **4** Competition - **0**



NETAFIM EMITTER CROSS SECTION



COMPETITIVE EMITTER CROSS SECTION

While the volumes of the cross-sections of these two emitters pictured in blue are equal, the 'most near square' emitter will pass the largest particle (pictured in orange) and is therefore less likely to clog.

Now, let's put what we have discussed to the test by looking at real-world data.

A test was done in 2007 by a copper mine to determine the best product to use. To ensure that the test results were unbiased and as accurate as possible, the mine used their own personnel, installing both Netafim and a competitive dripline onto the same pad in alternating rows and they used the same design program to determine flow. At the conclusion of the test, the competitor's driplines clogged over 4 times as much!

FINAL TEST RESULTS	
NETAFIM DRIPLINE	**COMPETING DRIPLINE**
• Design-calculated was flow rate was 5.87 GPM • Actual end-of-cycle flow rate was 5.24 GPM • 10.7% clogging rate • Was 89.3% functional at the end of the cycle	• Design-calculated was flow rate was 5.62 GPM • Actual end-of-cycle flow rate was 3.13 GPM • 44.3% clogging rate • Was only 55.7% functional at the end of the cycle

With over 40 years of expertise as the world's leading drip manufacturer, the proven technological advantages Netafim offers its customers ensures the highest possible production.

NETAFIM™

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