Technology Investigation: Filter Bags

The removal of suspended solids from vegetable washwater is a major challenge for the Holland Marsh Growers' Association (HMGA) Water Project. These solids can be soil particles, vegetable pieces, and other organic material. When suspended, the solids give water a cloudy or murky appearance. Regulations dictate that water must have a certain level of clarity before being discharged into the environment; therefore, treating washwater to remove solids is an important aspect of any treatment system.

After preliminary investigation, a technology that showed promise was filter bags. The concept itself is simple, but the execution can be complicated, as demonstrated by the path taken to the final conclusions. Filter bags are, at their simplest, a large fabric bag that trap solids within and allow water to seep out. The process by which this happens can be manipulated for maximum efficiency.

The first step in testing this technology was to create a small scale test rig with a non-woven filter bag (Figure 1). Washwater was pumped out of a settling tank and into the bag; the outflow was returned to the same tank. Several issues were identified during this test. First, the pump was clogged by carrot chunks throughout the test which had to be manually removed. Second, the bag ruptured at the seam, ending the test and raising concerns about the viability of such a system under this type of situation. Third, according to the water samples taken during the test, the suspended solids were still above the acceptable level so further treatment would be necessary (Table 1). However, when the bag was opened, it was found to be filled with solids. Overall, this test

Figure 1: Filter bag test rig (top left), test in progress (top right), outflow from filter bag into settling pond (middle left), bag ruptured at seam (middle right), solids filtered by bag (bottom left), and water samples from inflow on left and outflow on right (bottom right)

was successful in proving the concept – the filter bag was able to collect solids from washwater. The execution would require adjusting in order to make it an efficient system.

Following the initial experiment, it was decided that this technology was worth pursuing. It was clear that outside input was necessary and Bishop Water Technologies was approached to provide expert knowledge. Prior to any further actions on-site, Bishop requested representative water samples to bench test and evaluate the feasibility of using their technology to treat washwater. The test was a success and it was agreed to pursue a pilot-scale demonstration.

Figure 2: Time lapse photos of the Geotubes® at the beginning (top), mid-way (middle), and end (bottom).

Bishop Water Technologies, in collaboration with HMGA Water Project, installed a pilot-sized Geotube® at the same site as the filter bag test, next to the existing two-cell settling tank (Figure 2). Prior to the test the site was graded with a slight incline away from the tank. A membrane was laid down on which the Geotube® was laid. Washwater was pumped at a rate of 350 L/minute from near the settling tank's inlet for the test. The water was sent through a dosing system where coagulants and flocculants were added at a rate dependent on the water chemistry and solid load. This is done to create larger suspended solids that can be trapped by the Geotube®. The test used two container bags that were 25' long and, once full, have a circumference of 15'. When lying flat the width was 7.5'. Once in the containers, waste larger than 40 microns was collected within and the treated water flowed out through the fabric. This water was gathered by the membrane and directed back to the settling pond by the land grading.

During the test, water samples were taken to evaluate the performance. Auto-samplers were installed at the pump inlet and where the treated water flowed back into the settling tank. They were programmed to draw samples every 10 minutes throughout the day to form a composite sample. Additional grab samples were taken over the course of the four hour test; at the beginning once the system was in full operation (#1), mid-way through (#2), and at the end of the test (#3).

Table 1: The Total suspended solids (TSS), total Kjeldahl Nitrogen, total Phosphorus, and carbonaceous biological oxygen demand (CBOD) removal from vegetable washwater during the filter bag test and Geotube® test (both the composite sample and 3 grab samples throughout the four hours)

		Filter Bag	**Geotube®**			
			Composite	**#1**	**#2**	**#3**
TSS mg/L	**Pre**	216	1130	170	136	126
	Post	274	19.1	29.9	13.2	9.8
Total Kjeldahl Nitrogen mg/L	**Pre**	10.3	13.0	7.77	6.15	5.54
	Post	9.17	2.28	2.87	1.95	2.00
Total Phosphorus mg/L	**Pre**	3.70	2.56	2.34	1.47	1.33
	Post	3.41	1.00	1.65	0.91	0.82
CBOD mg/L	**Pre**	443	154	157	90	80
	Post	369	120	194	45	88

The results from the water samples demonstrate the Geotube's® ability to reduce the solid load of the water (Table 1; Figure 3). On average the total suspended solids (TSS) was reduced 91%. The post-treatment TSS concentrations were below predicted discharge limits. While the insoluble forms of nutrients are captured with the solids, there was still some soluble nitrogen and phosphorus present in the treated water which could require additional treatment prior to discharge. The carbonaceous biological oxygen demand (CBOD) was not reduced as much as expected and would also necessitate further available treatment options to polish the water. It is important to note that the treated water was returned to the same tank where the washwater was pumped from; this caused a dilution effect over the course of the test, as shown by TSS, nitrogen, and phosphorus in pre-treatment water. The TSS value for the pre-treatment composite sample is exceptionally high in comparison to the other samples (Figure 3), this sample was taken over the course of the day and most likely gathered more solids than the grab samples.

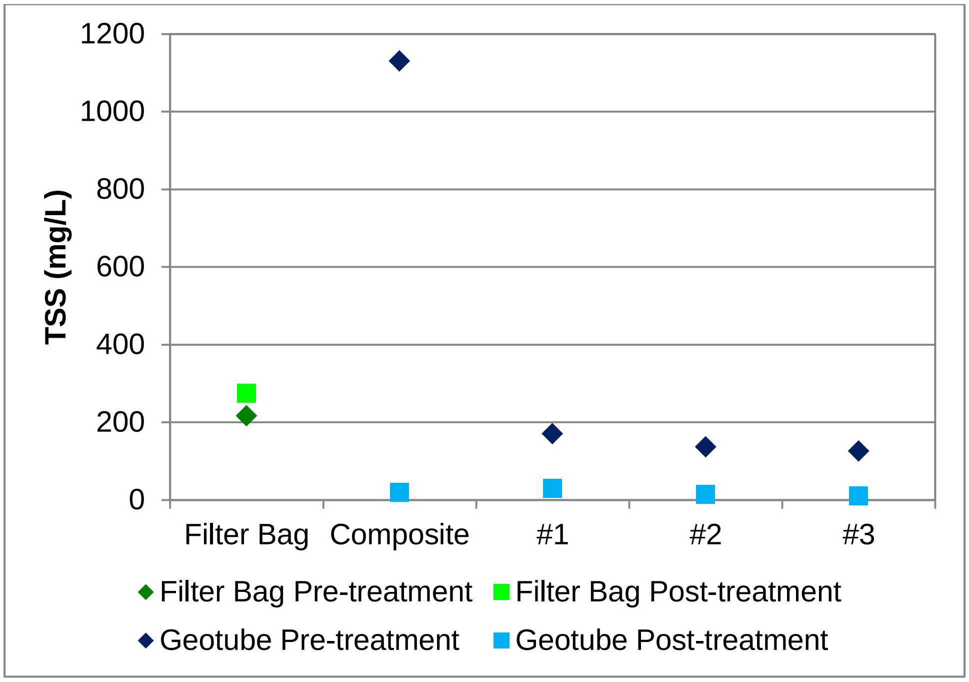

Figure 3: Total suspended solids (TSS) pre and post treatment during the filter bag test and Geotube® test (both a composite sample and grab samples throughout)

The Geotube® process addressed several of the issues raised by the initial filter bag test. Unlike the non-woven, Geotube® is a high strength woven structure, specifically design for dewatering applications. As such, the fabric and seams withstood the incoming water pressure; the seams were not a weak point that allowed untreated water to bypass treatment. Pre-treatment of the washwater with coagulants and flocculants caused the solids to combine into larger compounds that were trapped by the woven fabric. The visible differences between the incoming and outgoing water from the Geotube® is in direct contrast to the filter bag (Figure 1, bottom right; Figure 3; Figure 4). The

Figure 4: Water samples prior to treatment (left), immediately following the addition of coagulants and flocculants (middle), and post-Geotube® (right). The top and bottom pictures were taken approximately 1 minute apart, demonstrating the speed of settling once the solids have flocculated.

final problem presented during the filter bag test, the clogged intake pump, can be avoided by utilizing a chopper pump or with a pre-treatment to remove the large pieces.

This technology is a viable option to treat vegetable wash and flume water. The amount of pre-treatment required is based on the solids load of the wastewater. Initial capital costs include the coaglation and flocculant treatment system, pumps, piping and tanks. The on-going operating costs include the treatment chemicals, the filter bags (whether Geotube® or a different style), and any related operating and maintenance costs.

More information on the Geotube® Dewatering Technology can be found at bishopwater.ca/geotube and on the project activities can be found at hmgawater.ca.

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