Mycofiltration and Knysna Estuary

Fungi in Biotechnology

Prepared for Knysna Municipality

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Consider Mycofiltration as an option to filter out pathogens from a water stream entering Knysna Estuary.

Abstract:

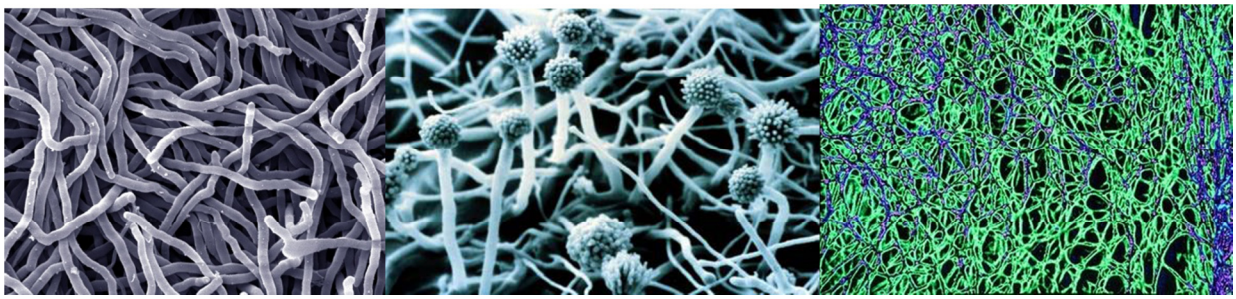
Mushroom mycelium is the invisible body of what we call mushrooms, and is usually not apparent to the untrained eye. The most common type of mycelium is what we see as mold growing on an aged orange in your kitchen. The mushrooms we find on the lawn or in a Pine Forest are the fruit of an invisible network of mycelium that form association with trees and other plants. Knysna Forest is surely to have millennia of mycelium growing all over the base of the landscape. Mycelium of many species of mushrooms will create rhizomorphs that in appearance very closely resembles plant roots. If you imagine millions of these fine hairy roots, overlapping and completing an entire network of threaded roots in search of food, water and nutrition, you can see the possibility of this model serving as a biological filter.

Different types of fungi have different jobs in our ecosystem. The type of fungi we consider for use in the bio filter would be called saprophytes. This type of fungi is a primary decomposer, and will inhabit and break down dead wood and various other organic materials. The process used by the fungi, to break down the hydro-carbons in wood, gives mushroom mycelia the ability to break down various other pathogenic micro-organisms as well.

Oyster mushroom mycelium is equipped to break down the complicated carbon chains in petrochemical products[6], some fungal strains have recently been discovered that can inhabit and digest plastic waste in dumpsites.[7]

If for instance I have a straw bale infused with Oyster mycelium, I can have water pass through the straw bale, feeding the mycelium and in turn being filtered clean. Oyster mushroom mycelium is known to also digest and neutralize E.colli bacteria amongst a list of others. Wheat straw itself has various beneficial bacteria and other microorganisms that will aid in filtering and cleaning water.

By using stone gabions, to slow the flow of water in the stream, a small maze is created to direct the flow of water. We can them place our straw bales in the path of the water and allow the water to flow through the bio filter. One or two layers of straw bales can be used, depending on the flow strength of the water. A 300mm layer of wood chip can be placed over the straw bales to avoid rapid evaporation and to ensure the health of the delicate mycelia. Over a three month time the mycelia will start to inhabit the wood chip as well, and after 1 year would have completely inhabited from straw base layer to wood chip top layer. This biofilter will be active for up to three years, while digesting the organic matter in the biofilter. After one year into the process, I foresee quite a bit of shrinkage, and a top up layer of woodchip can be placed atop the year old biofilter, to replenish food, and recreate the bulk in the filter. The waste from the biofilter can be used as humus rich compost.



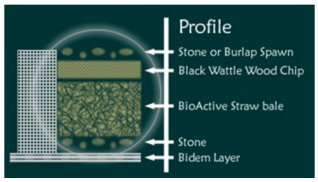
The pictures above are of fungal mycelia at work. You will notice the dense network they form.

Practical application

The landscape is one of the more important factors to consider - for example the outlaying area, where the source of contamination is introduced to the water stream and the topography of the landscape. Consider the environmental impact of building a biofilter in line with the water stream.

Construction

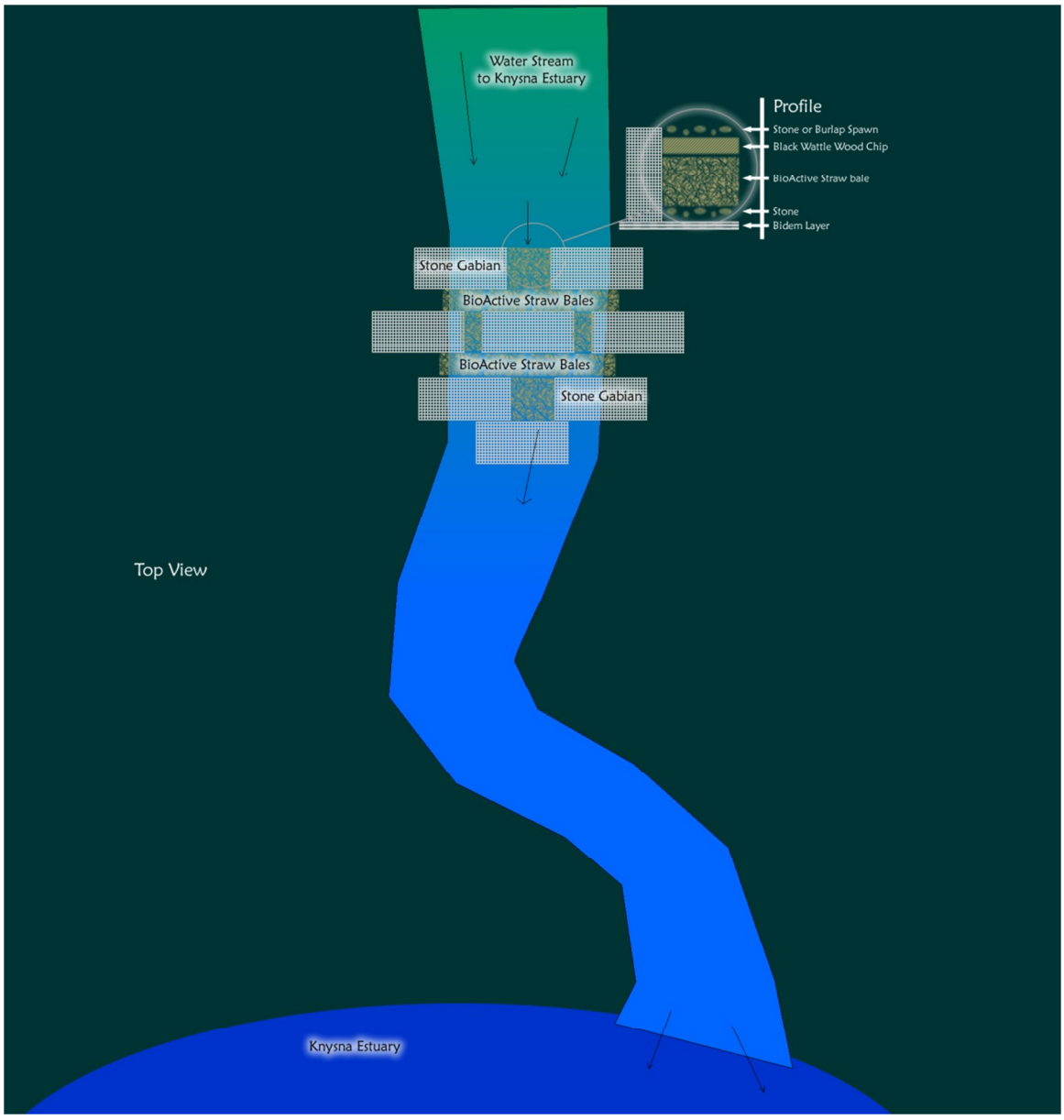
The water maze is constructed in the flow of water using stone gabions. The form of the gabion structure will depend on the terrain and the flow of water. The water must be forced to flow through the stone gabions and accommodate relative flood water as well.



A layer of bidem is placed on the prepared stream floor. On this bidem layer we place stones to keep the bidem fabric in place. The stone gabions are placed and secured on top of this layer. BioActive straw bales are stacked between the gabion blocks and acts as the main biofilter. To keep the straw bales in place and regulate the BioActive straw bale humidity, we can line the topmost layer with stones or bunker spawn (hessian bags filled with woodchip and mycelia of Pleurotus Ostreatus.) The bunker spawn layer on top of the BioActive straw bales and the wood chip layer under that acts as secondary bio filters, as they will grow rich with mycelium.

Stone Gabions dual work as structure and particle filter. Straw Bales are pasteurized and inoculated with Pleurotus Ostreatus to become BioActivate.

Possible examples of constructing a BioFilter:



Mycofiltration for Knysna Estuary.[4] This diagram shows the water flow to the Knysna estuary and a BioFilter in place to block and absorb pathogenic microbes from entering the downstream water.

Pleurotus Ostreatus Culture and its activity against chemical toxins:

Active against – Benzopyrenes, Dimethyl Methyl phosphonate (VX, Soman, Sarin), Dioxin, Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls, Trinitrotoluene (TNT).[1]

Pleurotus Ostreatus Culture and its activity against heavy metals:

Active in up channeling heavy metals (Cadmium and Mercury) from mycelial habitat.[2]

Pleurotus Ostreatus Culture and its antimicrobial effect on organic pathogens:

Pleurotus Ostreatus shows strong antimicrobial effect on the following microbial pathogens. Aspergillus niger, Bacillus spp., Escherichia coli, Plasmodium falciparum, Pseudomonas aeruginosa, Pseudomonas fluorescens and Staphylococcus aureus.[3]

Effective Micro-organism(EM™) are reintroduced from the BioFilter

The addition of EM™ Mud Balls to the Biofilter mass, will aid in the rehabilitation of beneficial micro-organisms downstream. [5]

References:

1) Mycelium Running by Paul Stamets.[1][2][3][6]

2) Mycofiltration for Knysna Estuary – Conceptual Diagram by Dawid A Reynders[4]

3) EMRO – Japan - http://emrojapan.com/application/environment/water-purification.html [5]

4) http://www.fastcoexist.com/1679201/fungi-discovered-in-the-amazon-will-eat-your-plastic [7]