

Characterization and Productivity of Microalgae Species Grown on Bioreactor for Wastewater Remediation

Jacob Accordino, Andrew Nielson, *Utah State University* | Ron Sims, PhD, *Utah State University*

I. Abstract

The present study examines the effectiveness of various plastics as growth substrates for microalgae and identifies the algae strains that culture best on the given materials. The findings will aid in making the treatment of wastewater more efficient and sustainable.

It was found that filamentous strains of microalgae grew more predominantly during cold months while single-celled *Chlorella vulgaris* thrived during warmer temperatures.

HDPE White was the disk material with the highest average productivity of biofilm adhesion.

II. Introduction

Rotating Algal Biofilm Reactors (RABRs) are bioreactors first developed at Utah State University for enhancing the treatment of wastewaters using microalgae. Plastic disks are placed upright on an axle, half submerged in wastewater, and rotated at low velocities (Figure 1). The reactor is then inoculated with algae, with the disks serving as growth substrates. The cultured algae form biofilms on the rotating disks and remove harmful nutrients from the wastewaters in order to prevent eutrophication of receiving waters. Algae are periodically harvested to allow for continued growth, and the biomass can then be processed into various resources including compost, biofuels, and feed supplements.

The RABR used as the test environment had ten substrate disks (1.2 meters in diameter) fashioned from ten different polymer-based materials. Polystyrene disks were also cut and fixed to one side of each plastic disk to serve as controls. The disks were inoculated with algae taken from trickling filters and left to treat municipal wastewater at the largest treatment plant in the state of Utah, which processes 60 million gallons per day.

III. Methods

Two separate samples of algae were regularly harvested from each of the ten disks at the RABR. Glass slides were prepared from the first sample and examined under a microscope to determine the strains of algae present on each respective disk. The second sample was harvested from the same section of the disk each time (area of 0.03 m²) in order to calculate the productivity of biofilm growth in g/m²/day. The masses used to determine the productivity of each disk were obtained by drying the samples in an oven for 24 hours.

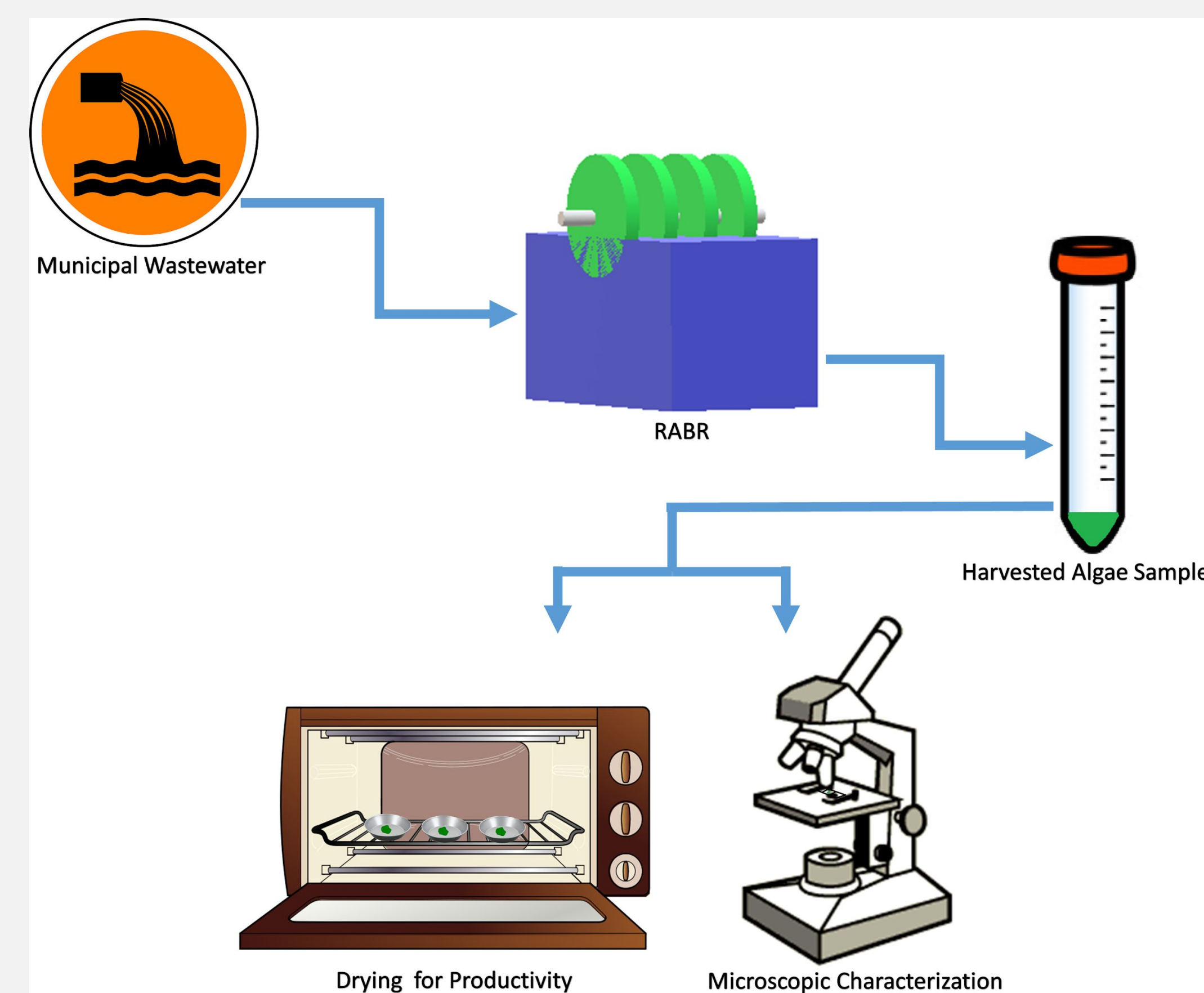


Figure 1. Process used to harvest algae and collect productivity and characterization data.

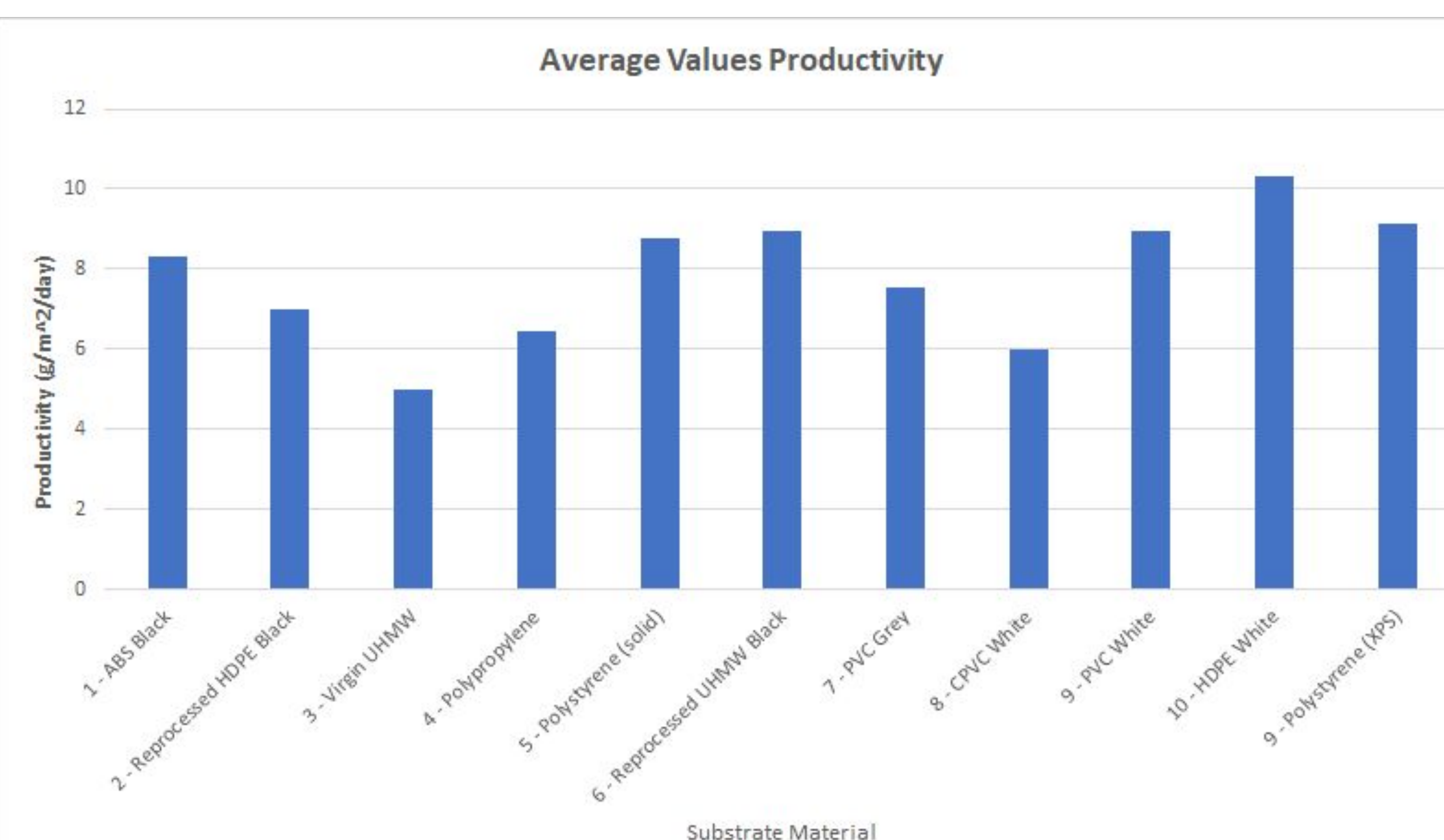


Figure 2. Average of the productivity values for the ten disk substrates from Jan 15 to March 27

IV. Results

Initial samples revealed almost purely filamentous strains of algae such as those from the *Klebsormidium* and *Stigeoclonium* genera. Later samples were composed of a variety of different strains. However, none was as prevalent as *Chlorella vulgaris*. As the temperature warmed, the *Chlorella* thrived and other strains began to disappear. Of the filamentous strains, only the *Klebsormidium* seemed able to maintain a presence on most of the disks as the temperature increased. However, even they began to disappear as the *Chlorella* became the dominant presence.

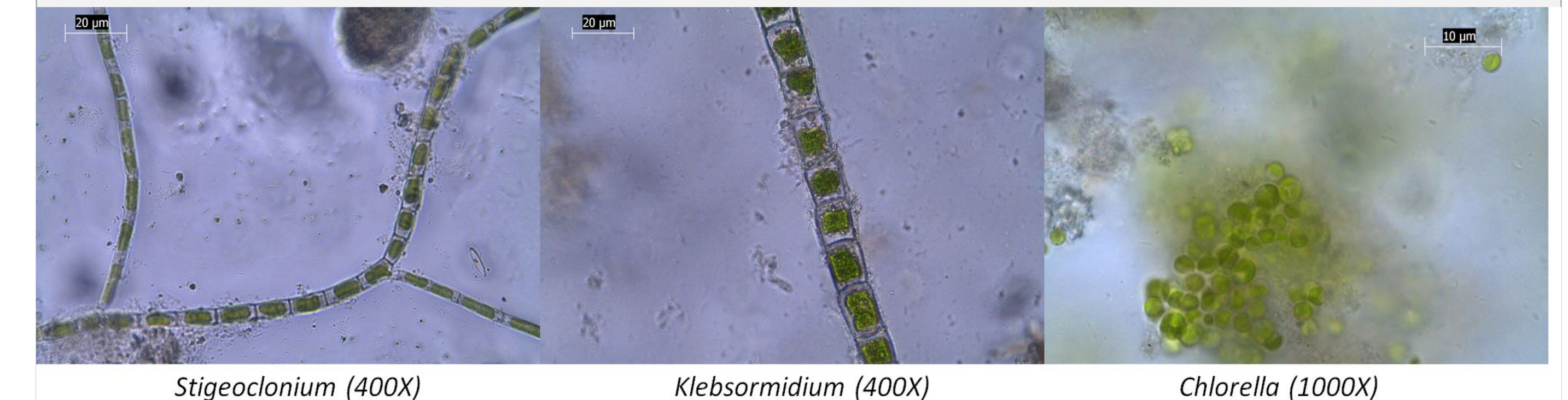


Figure 3. Most dominant strains of algae found on the RABR disks.

In terms of productivity, the HDPE White was the substrate that performed best while the Virgin UHMW had the lowest average of biofilm adhesion per day (Figure 2).

V. Conclusions

- White HDPE appears to be the most promising material for implementation in biofilm dependent reactors
- RABRs implemented in wastewater treatment plants at cooler climates will be better inoculated and maintained with filamentous algae, while plants at warmer locations will see greater productivity using *Chlorella v.*
- Future work includes examining and comparing the effectiveness of filamentous vs. single celled algae genera at the uptake and removal of nutrients from wastewaters.
- Other future projects will entail determining the percent composition of the collected biomass that consists of green algae

Study conducted with funding from a USTAR Industry Partnership Project Grant and lab assistance from the USU Department of Biological Engineering.
jake.accordino@aggiemail.usu.edu andrewnielson77@gmail.com