



A plant-wide analysis of an industrial flocculation process in biomanufacturing

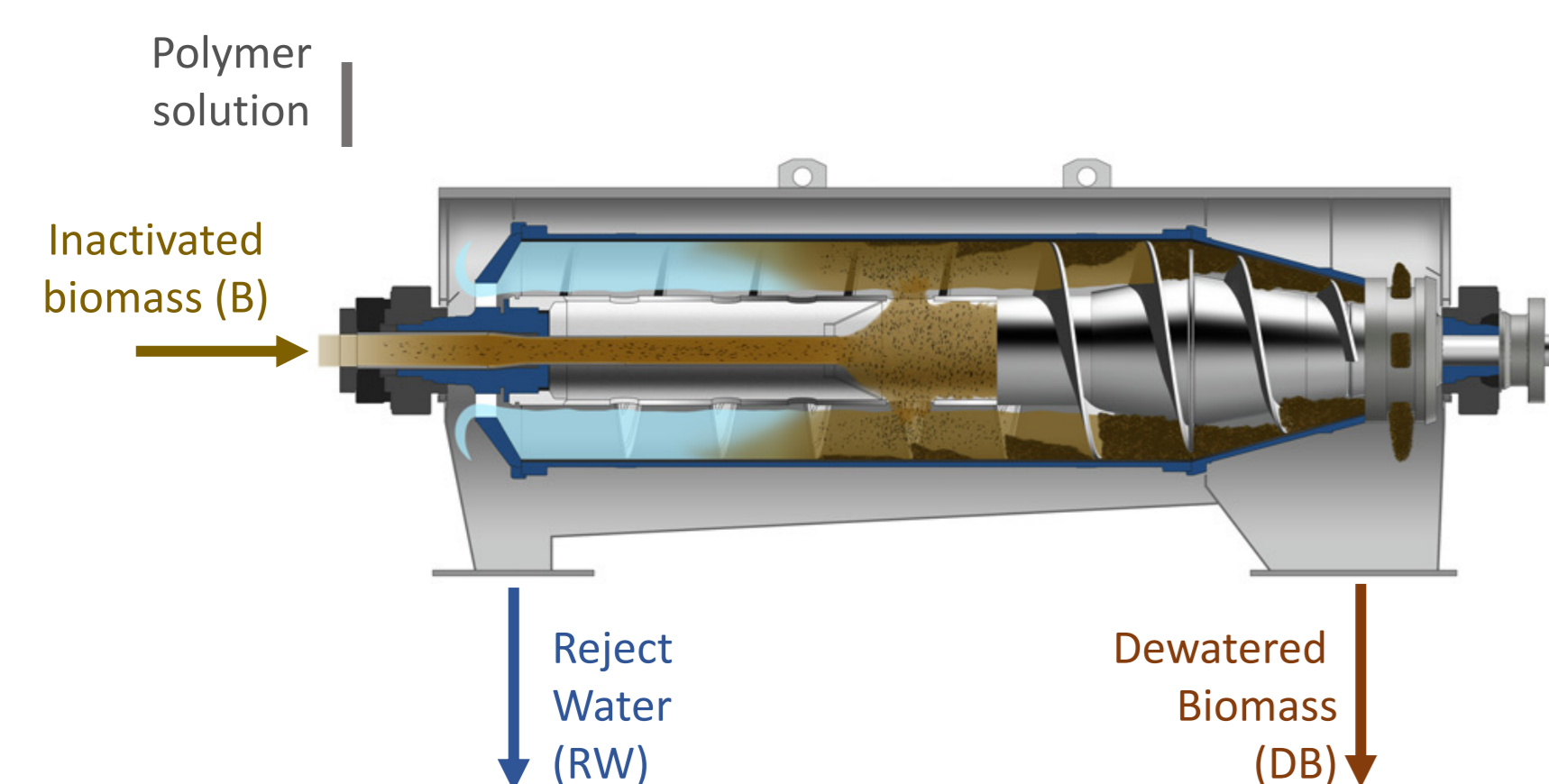
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Helix Lab

Introduction

The industrial wastewater treatment plant (iWWTP) from Novozymes processes an organic load equivalent to a 2.4 million people city, positioning it as the largest iWWTP in Northern Europe. More than 4000 m³ of biomass slurry are dewatered every day in decanter centrifuges. The efficiency of this operation has a direct impact on resources and revenue of the iWWTP.

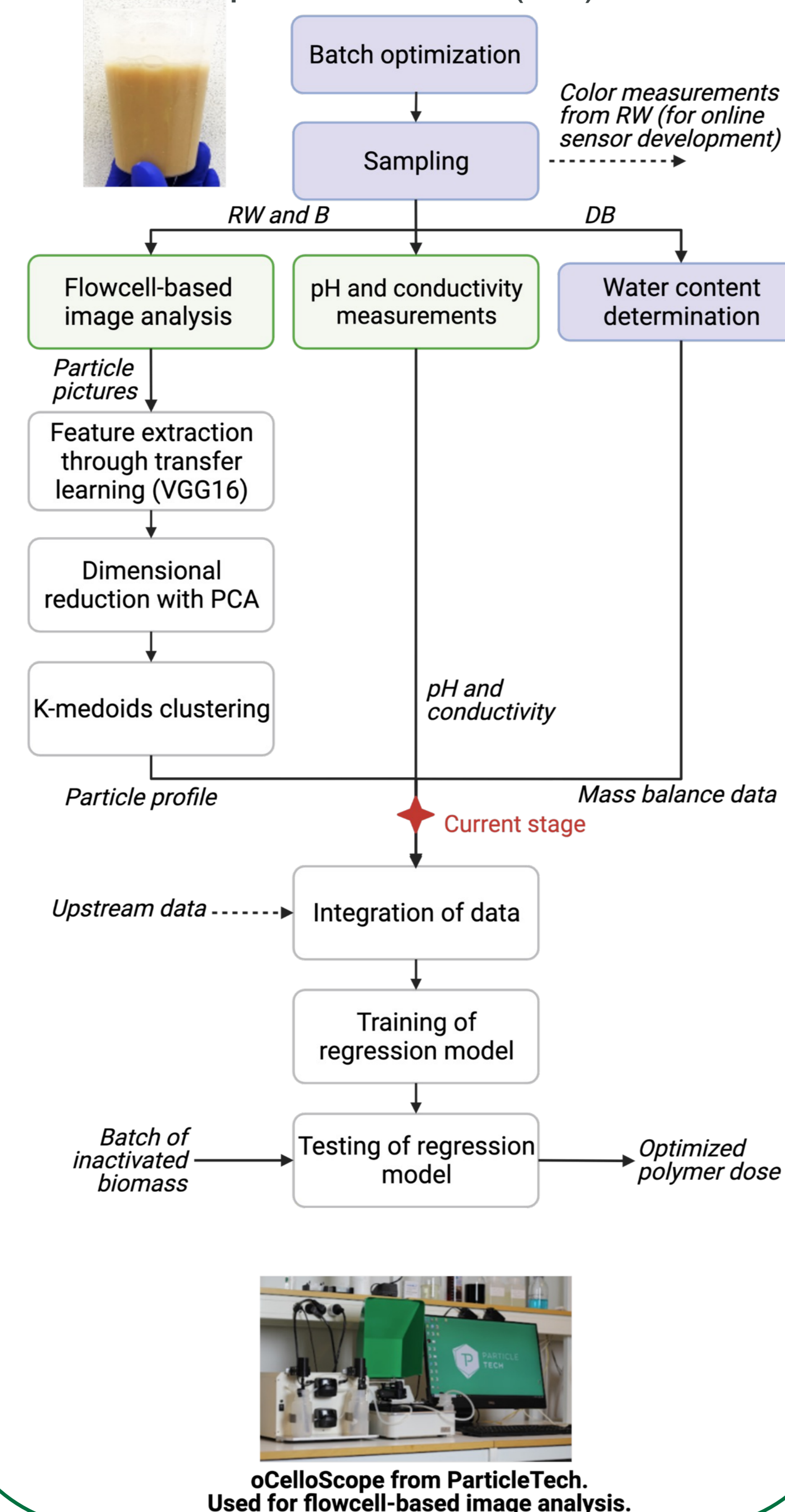


The operators select the chemical dosages that aid the dewatering step around the clock. When upstream production changes, so does the need for chemicals. Moreover, the particle processes in complex dynamic systems, such as decanter centrifuges are poorly understood. The aim of this project is to develop a data-driven model that relates plant-wide operational conditions and particle images to the dewatering efficiency. The model will help to understand the underlying particle processes and serve as a first step towards automation of the chemical dosage procedure.

This is an ongoing project that is being carried out in close collaboration between Tec de Monterrey (Mexico), DTU, Novozymes and Helix Lab.

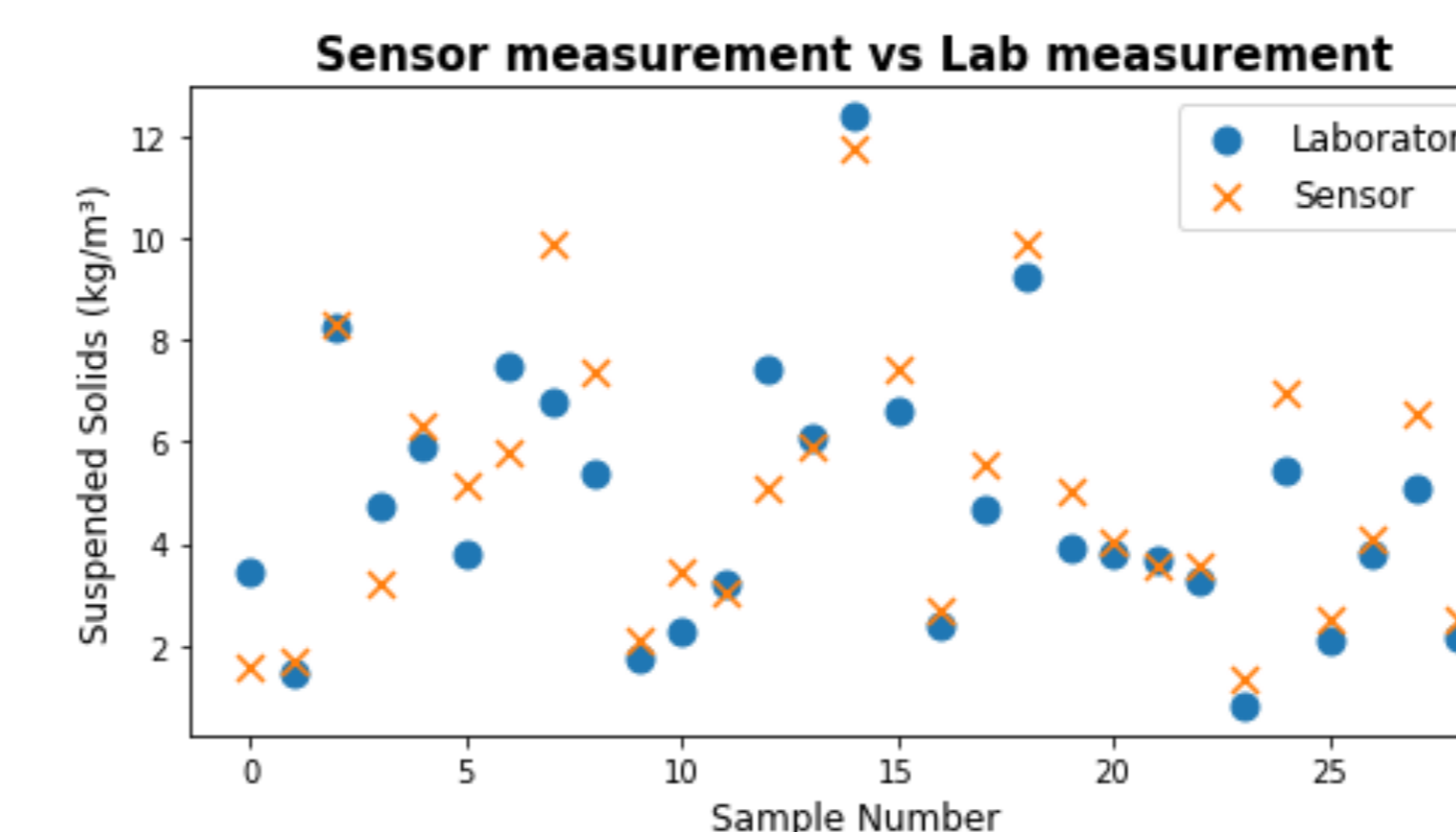
Methods

A main measuring campaign was conducted over 15 production batches, and 3 operational levels for data collection for the prediction model. A secondary campaign on RW of different qualities had the purpose of developing an online sensor for reject water quality in terms of suspended solids (SS).

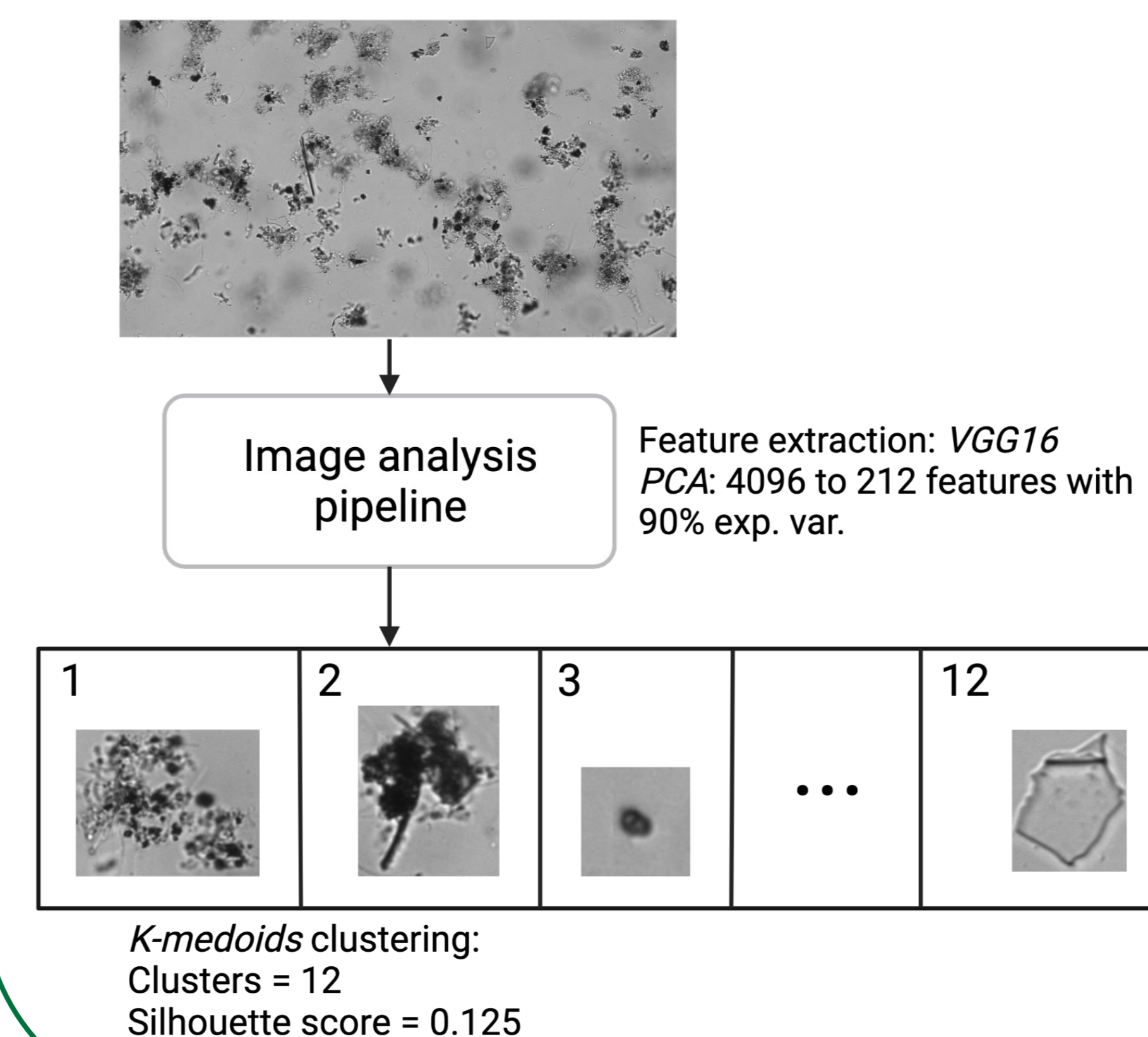


Outcome

A Random Forests model was trained and tested with color (independent variable) and SS (dependent variable) values of RW from 18 batches. This model has an accuracy of 80% and an average error of 1 kg/m³ in a 0.5 to 18 kg/m³ range. The implementation of the developed online measurement system will aid in monitoring the dewatering unit in the iWWTP.



In the main campaign, batches showed different responses to polymer dose. From the B samples, particle population was divided into 12 main clusters.



The final step is to build, train and test a prediction model that integrates online data with particle profile defined by clustering.

Laboratory measurements and upstream data					+	Particle profile				
Batch	SS	pH	Polymer	Etc.		Batch	K1	K2	...	K12
1						1	0.3	0.0	...	0.1
...					
15						15	0.1	0.2	...	0.0

= Separation quality

The result of this project is a step towards automation of the dewatering operations at the iWWTP. This could lead to reorientation of resources to other critical operations.

Perspectives

This project has been a great learning and cultural experience from start to finish. The project got me to fulfill my goal of doing my MSc project at a full-scale biomanufacturing facility giving me the opportunity to learn how complex problems are solved in industry. The project enabled me to mature both, my analytical and programming skills. I had the opportunity to work with novel technology from ParticleTech and learn how concepts from the field of artificial intelligence and machine learning can be used to analyze images and online sensor data. Finally, it brought me to a country that is not as exotic as Mexico, but full of other delights, and I am hoping that I can get to work here and learn how to pronounce "rød grød med fløde".