CASE STUDY

From Idea to Proof of Concept—A City of Martinez Case Study

In 2024, the City of Martinez CA water treatment plant upgraded its polymer activation equipment by installing a Polyblend® unit to activate and feed and polymer solution to the belt press for sludge dewatering.

Traditionally, once a week, operators conducted a startup of the belt press, manually adjusted the polymer dose once steady-state conditions appeared and intermittently monitored dewatering operation and cake quality throughout the day. This practice, although familiar, introduced variability: operators with different levels of experience would interpret visual cues differently, often erring on the side of higher doses to ensure dewatering targets were met, and spending considerable time walking back and forth to check sludge appearance and cake quality.

Figure 1: Belt-press, City of Martinez WTP and Polyblend® installed in May 2024

At startup, our principal scientist, Dr. Robin Giguere, noticed that the color and coverage of the sludge cake on the belt provided a clear visual indicator of dewatering effectiveness. Inspired by this observation, the team asked: what if a camera could continuously monitor these cues and deliver feedback directly to an operator or the control system? This question set the stage for the SludgeVision proof of concept.

Figure 2: Sludge dewatering is a highly visual process

Figure 3: Waterproof camera mounted above the belt press using magnet.

In Fall 2024, the team began by installing a rugged, waterproof IP camera above the dewatering zone of the belt press. A prototype of the SludgeVision Base Station was also installed, consisting of an industrial mini-computer, running prototype software that captured high-definition images and analyzed them in real-time with computer vision algorithms.

Within minutes, the SludgeVision controller was operational, processing images in real time to distinguish between the green belt, brown sludge, and any obstructing elements. Key performance metrics—such as the fraction of belt versus sludge coverage—were displayed alongside live videos on the local HMI, allowing operators to see both historical trends and current conditions.

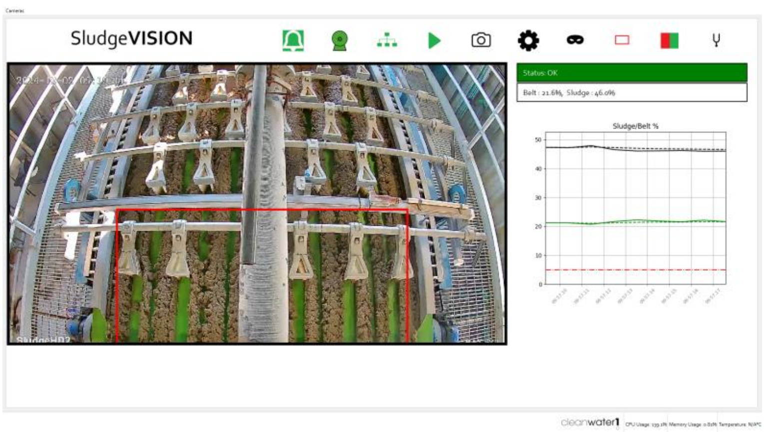

Figure 4: SludgeVision software showing the sludge dewatering and process variable in real-time

Over several weeks of testing, the team evaluated how polymer dose and dilution water impacted belt-fraction metrics obtained by the SludgeVision system.

By monitoring the response to changes in polymer dose, we observed a strong correlation between the amount of polymer added and the computer vision feedback. For example, in Figure 5 the process parameters (dilution water, sludge flow, belt speed) remain constant while only the polymer pump speed is varied.

The data reveal a clear plateau: beyond a certain polymer dose, improvements in sludge separation become negligible, indicating diminishing returns on chemical usage. In other words, once you surpass that threshold, adding more polymer does not enhance dewatering performance observed by the camera.

Parallel cake dryness tests confirmed this finding: once the minimum effective dose was reached, further increases in polymer had no significant effect on moisture content. Across all tested doses, cake dryness remained between 84 % and 86 %, regardless of the polymer dosage. This demonstrates that applying more than the minimum required polymer yields no additional benefit in cake dryness.

The Polyblend® is equipped with two dilution water lines: one at the polymer activation chamber (primary dilution) and a second "post-dilution" line downstream, to adjust further down the polymer concentration feed dose to the sludge stream before entering the belt-press. While the primary dilution ensures optimal polymer activation, the post-dilution line allows the operator to lower the polymer concentration further if the downstream separation process demands it.

Figure 7 illustrates how varying the post-dilution flow rate affects the belt vs. sludge fraction at a fixed polymer dose. In our trials, increasing post-dilution consistently reduced dewatering performance—suggesting that, under these conditions, post-dilution should be disabled.

Figure 8 compares performance with and without the normally used post-dilution. The curves are similar: both show an optimal polymer dose, beyond which additional polymer yields no further improvement in visible belt or sludge fraction. Moreover, disabling post-dilution and then reducing the polymer dose produces the same belt/sludge fraction results while saving polymers.

In practical terms, to maintain a target belt fraction of 40 %, we were able to reduce the polymer pump speed from 11 Hz to 9 Hz—a full 18 % reduction in polymer usage—simply by turning off the post-dilution line. The immediate feedback from the SludgeVision system allows to optimize the post-dilution for given conditions fairly rapidly.

Armed with these insights, the team implemented a closed-loop control solution in which SludgeVision's belt-fraction output drove the polymer pump directly. A Polymer Control System prototype—comprising an industrial PLC/HMI—was installed alongside SludgeVision. The PLC continuously monitored belt-fraction metrics, adjusted the polymer feed pump, and triggered alarms that defaulted the system to a safe mode if communication was lost or abnormal conditions were detected.

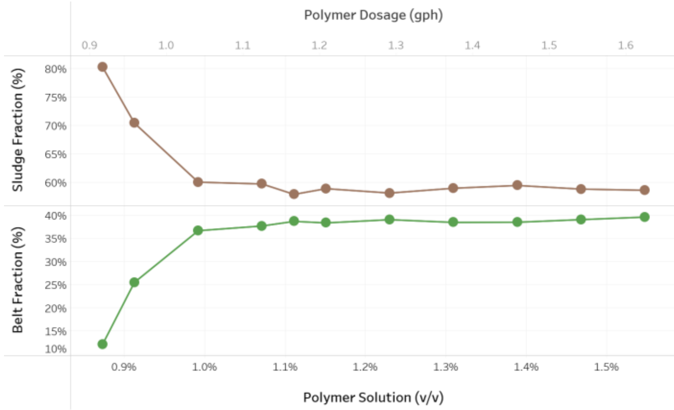

Figure 5: Influence of polymer dosage on belt and sludge fraction at constant polymer flow of 0.96 gph.

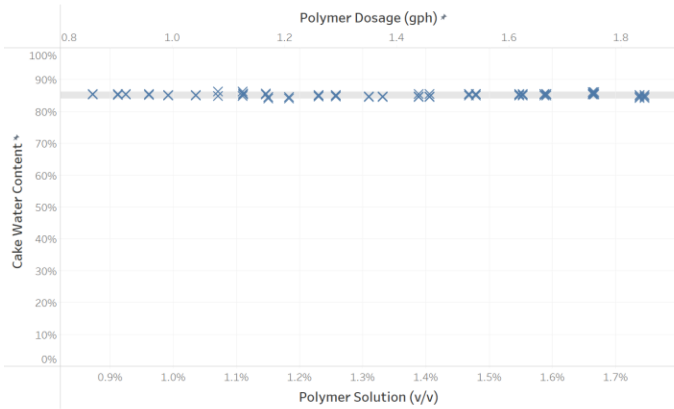

Figure 6: Cake dryness results for various polymer doses.

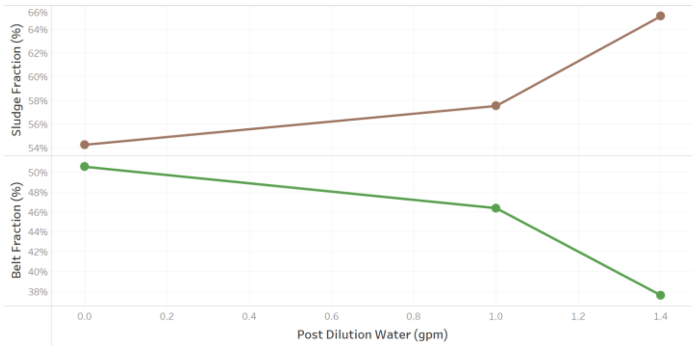

Figure 7: Influence of post-dilution on belt and sludge fraction at constant polymer sage.

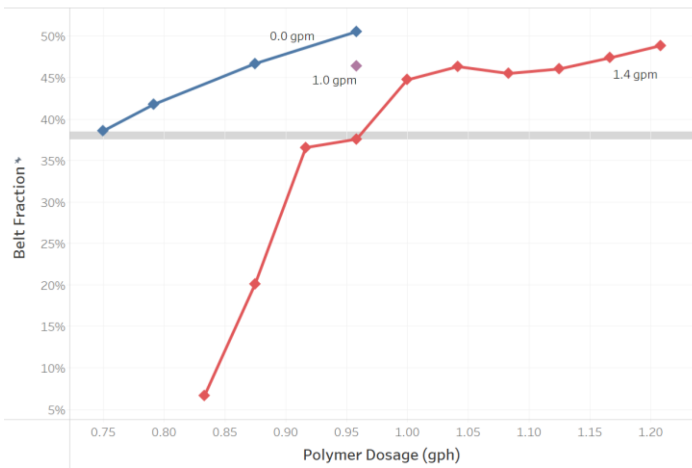

Figure 8: Influence of polymer dosage on belt and sludge fraction w/o post-dilution.

Figure 9 illustrates a typical trial. Initially, operators performed a standard belt-press startup and manually tuned the polymer dosage until steady-state conditions were reached. At that point, the Polymer Control System was activated. It automatically reduced the polymer pump speed to achieve and maintain a belt fraction of approximately 25 %. In this example, the operator’s initial setting of 20 Hz was trimmed down to about 13 Hz once the controller was in control—a 35 % reduction in polymer usage.

In summary, the SludgeVision proof of concept demonstrated that the visual characteristics of sludge on a belt press—once the domain of subjective, manual inspection—can be accurately quantified and automated. By delivering real-time feedback, the system enabled significant reductions in polymer consumption and operator workload, while also enhancing the consistency and quality of dewatering performance. Moreover, clear, immediate insights into how both polymer dose and dilution water affect separation proved essential for fine-tuning the process. Together, these capabilities underscore SludgeVision’s potential as a scalable solution for optimizing polymer dosing and dilution strategies in water and wastewater treatment operations.

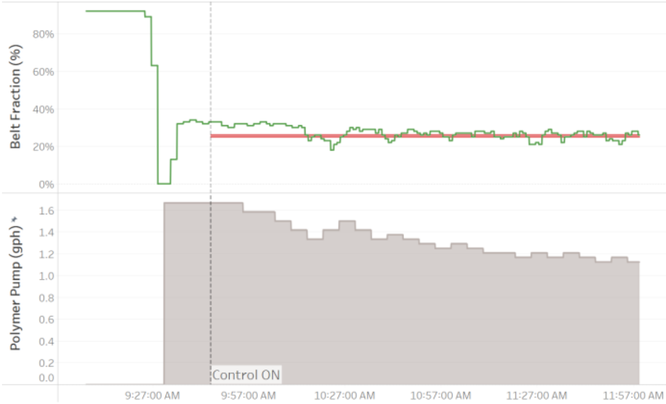

Figure 9: Example of polymer pump control based on belt-fraction from SludgeVision software.