



Automated System for Recycled PET with a Focus on Monitoring Intrinsic

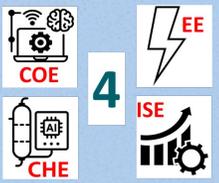
Viscosity (IV)

Khalid Altuwajjiri (CHE) – Saleh Altwajjri (ISE) – Fahd Alfahid (EE)

Yasser Alabduljabbar (ISE) – Sufyan Almohaimeed (EE) – Omar Alromih (COE)

Coach: Dr. Ismail Almaraj

Team: 075



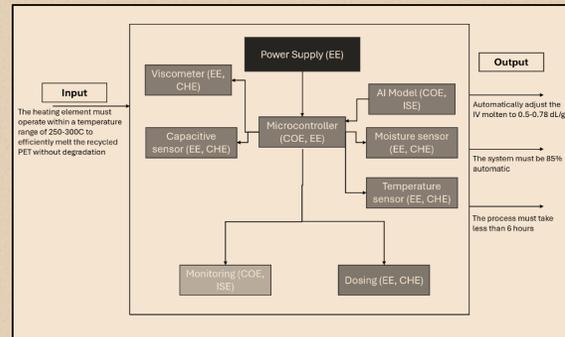
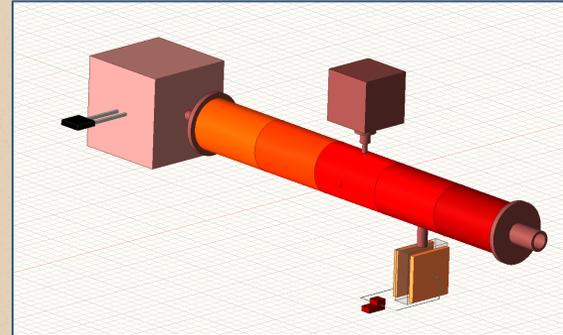
Introduction:

Recycled PET (rPET) is critical for sustainable industries like packaging, textiles, and automotive sectors. However, controlling the intrinsic viscosity (IV) during recycling remains a major challenge. The project designs an automated system capable of real-time IV monitoring and control, aiming to enhance operational efficiency, reduce material waste, and ensure product uniformity using advanced sensors, real-time data acquisition, and machine learning.

Problem Statement:

Inconsistent IV during rPET recycling causes waste, quality issues, and inefficiency. Without real-time control, over- or under-modification occurs, and manual methods remain slow and impractical.

Prototype Design:



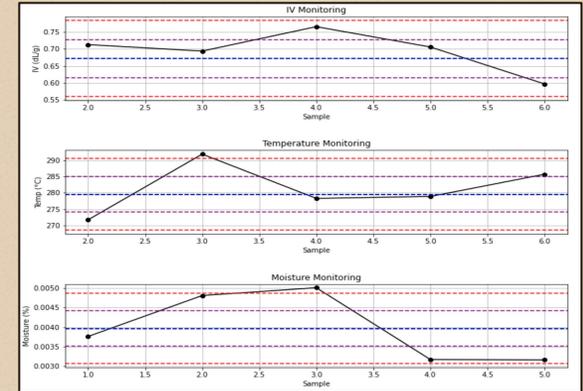
The system integrates sensors (viscometer, capacitive, moisture, and temperature) with a microcontroller and AI model for real-time IV monitoring and dosing. It operates within 250–300 °C, adjusts IV to 0.5–0.78 dL/g, automates 85% of the process, and completes production in under 6 hours.

The prototype maintains moisture content below 0.02% and limits material property variation to 5%. IV sensor accuracy is within $\pm 5\%$, with prediction accuracy for IV values above 90%. The system achieves at least 15% material waste reduction, keeps IV within 0.5–0.78 dL/g, and ensures production line automation exceeds 85%.

Testing & validation:

- Collected 100+ real-time sensor data samples (temperature, moisture, IV).
- IV prediction model (Random Forest) achieved over 90% accuracy.
- IV was maintained within the target range of 0.5–0.78 dL/g.
- Moisture content remained below 0.02% throughout tests.
- Alert system successfully triggered within 5 seconds of deviation.

Specification	Target Value	Met?
IV Range	0.5 – 0.78 dL/g	Met
Prediction Accuracy for IV	$\geq 90\%$	Met
IV Sensor Accuracy	$\pm 5\%$	Met
Moisture Content	$\leq 0.02\%$	Met
Variation in Material Properties	$\leq 5\%$	Met
Material Waste Reduction	$\geq 15\%$	Met
Alert Trigger Time	≤ 5 seconds	Met
Operating Temperature Range	250–300 °C	Met
System Cost Limit	≤ 6000 SAR	Met



The chart demonstrates that all (IV) values remained within the defined specification limits (0.50–0.85 dL/g), indicating a stable and controlled process. No points exceed the upper or lower control limits, confirming the system's ability to maintain consistent IV during rPET recycling.

Conclusion:

The system automates the monitoring and adjustment of intrinsic viscosity in recycled PET production. It meets key specifications, achieving over 90% IV prediction accuracy, automated dosing, and reduced material waste. Through advanced sensing, machine learning, and control, it improves efficiency, reduces manual work, and supports sustainable manufacturing.

Constraints

Specifications

All system materials must withstand operating temperatures of 250–300 °C	Variation in Material Properties $\leq 5\%$
The quality control system must meet statistical standards with alpha 0.05 and beta 0.10	Adjustment of IV for Molten PET: 0.5 – 0.78 dL/g
Material waste reduction $\geq 15\%$.	Prediction Accuracy for IV Values: $\geq 90\%$
Total system cost must not exceed 6000 SAR	Alerts must be triggered within 5 seconds if an out-of-control signal is detected.