LabVIEW Based Viscosity Profiler

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NI Product(s) Used:
NI LabVIEW 2013
NI cDAQ-9184
NI 9217
NI 9215

Category:
Advanced Research

The Challenge
Create a modular application that allows a chemical engineer the ability to characterize, in real-time, the viscosity of liquids as additives are combined while providing seamless transitions between characterization profiles and mixture control.

The Solution
Leverage LabVIEW's built-in ability to communicate via standard protocols to provide mixture control while combining the benefits of the NI Compact DAQ to create a flexible yet easy to replicate system for performing real-time analysis for viscosity profiles

Introduction
Data Science Automation (DSA) is a premier National Instruments (NI) Alliance Partner that specializes in automating and educating the world leading companies. Clients choose DSA because of DSA's deep knowledge of National Instruments products, disciplined process of developing adaptive project solutions, staff of skilled Certified LabVIEW Architects and Certified Professional Instructors, and unique focus on empowerment through education and co-development.

Legacy Control System
Prior to the investment in Data Science Automation and National Instruments products, DSA's client used proprietary, antiquated and costly measures to verify and validate the viscosity of its liquids. This procedure included a delicate dance between the operators, managers and stockholders. Due to the importance of the viscosity results in maximizing profitability while providing high-quality products, the operators were constantly under pressure to find the appropriate balance of material versus cost. This would place unnecessary burden on the operator to correctly characterize, via complex calculations and lookup tables, the viscosity of the additives in real-time using digital displays and rotary dials. The importance of these characterizations along with the added stress for accuracy caused costly overruns and delays in product development.

Approach
Data Science Automation empowered the client's operators with National Instruments LabVIEW along with Compact DAQ to control and monitor in real-time the viscosity while additional additives were being applied to a mixture. This approach was designed to remove the operator interaction with the antiqued acquisition systems and complex arithmetic and allow them to focus on the results (Figure 1). To accomplish this Data Science Automation had to create a system that would not only control mixture rates by analysis of a variety of signals while presenting the data in an easily understandable format while also providing the ability to the operator to adjust or modify the additives to produce the required viscosity.

Mixture Control
To maximize the client's investment, Data Science Automation integrated the client's previous mixing hardware within the new software. This was an extremely valuable component to the investment and was made possible by National Instruments LabVIEW and extensive Tools Network. From within the National Instruments Tools Network there was an available add-on for Ethernet communication that greatly reduces development time while leveraging known technology for the mixture process

Data Acquisition
The Viscosity Profiler system was created not only to replace an obsolete application but was also designed to increase the ability to accurately measure viscosity. Data Science Automation's design integrated a National Instruments compact DAQ platform due its ability to deliver high-speed data along with ease of use in flexible mixed measurement systems. National Instrument's LabVIEW programming environment provided Data Science Automation with the ability to create not only the required functionality but also increase the available types of acquisition that guaranteed the longevity of the application while minimizing production cost.

Real-Time Analysis
The heart of the Viscosity Profiler system was National Instruments LabVIEW's ability to acquire multiple signals types ranging from temperature sensors to current values simultaneously while providing a platform for converting the sensor data into processed data. The real-time analysis would not only remove the operators reliance on external devices that they manually read but allow them to apply complex filters to high speed simultaneously sampled data to ensure highly accurate results. By using National Instruments compact DAQ hardware the client was able to also receive highly repeatable results that further supported their viscosity models for additive mixtures. Along with the real-time analysis, National Instruments LabVIEW also provided Data Science Automation with a platform for creating aesthetically pleasing displays that guaranteed the longevity of the application while minimizing production cost and operator stress (Figure 2).

National Instruments Support
The success of this system relied on National Instruments' ability to provide a stable and robust operating environment while providing the software tools to allow for rapid development and debugging. The ability to quickly integrate compact DAQ along with the expandability of industrial communication standards through the Tools Network allowed DSA to meet the client's operational requirements for a modest cost. Once complete, the system replaced an antiquated, error prone process that took days if not weeks to implement with an automated system that would give the operators, managers and stakeholders real-time feedback on their mixing profiles. This saved the company hundreds of man-hours redoing faulty, error filled tests while providing a modern system with real time analyses that can be expanded to meet both near term and long term goals of providing low-cost, high-quality products.

Benefits of Partnership
The Alliance partnership between Data Science Automation and National Instruments has allowed DSA to tackle many extremely complex engineering challenges while maximizing our clients' return on their investment. The Viscosity Profiler project was no exception. By selecting LabVIEW and USB cDAQ Data Science Automation was able to create a system that not only reduced the overhead costs but also greatly increased the client's productivity and profitability by enabling them to reduce excess material and provide real-time profiling. Also by using National Instruments hardware and software, the Viscosity Profiler application was enabled the client to purchase off-the-shelf equipment, specifically in the area of motion control, cDAQ and LabVIEW. These savings allowed additional investment in the development and enhancement of their application.

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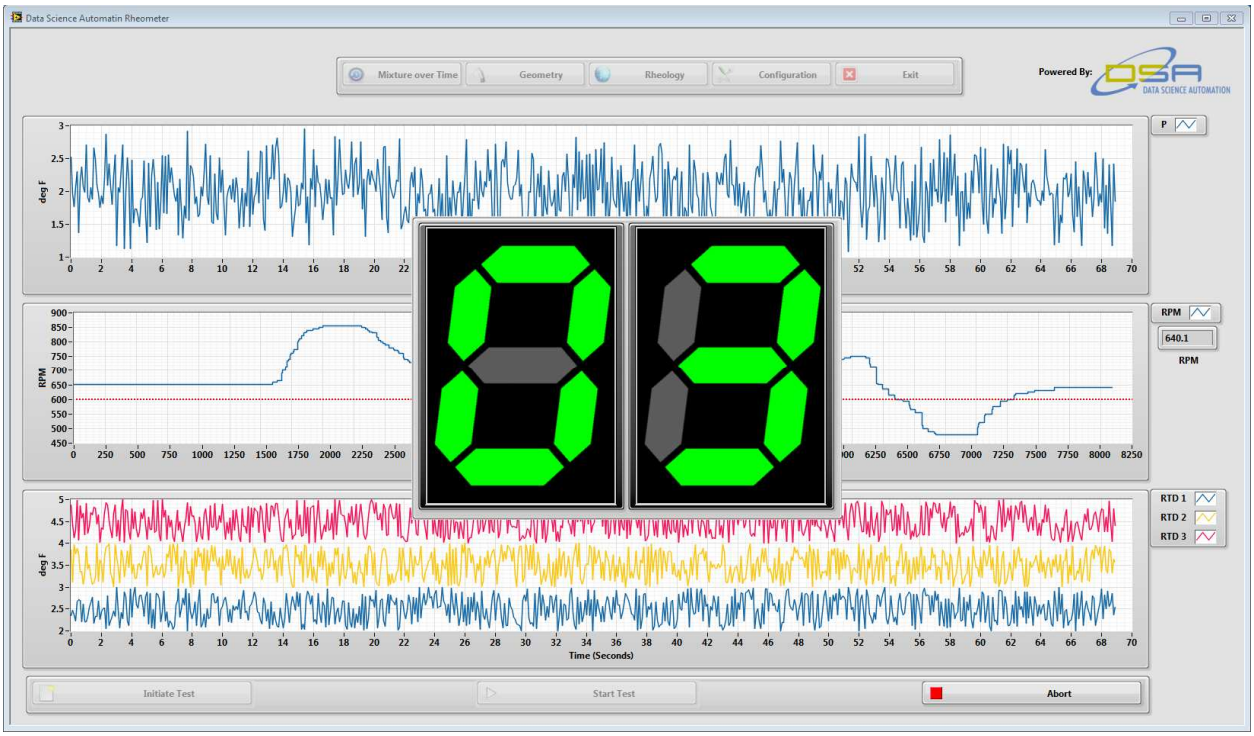

Figure 1-General Mixture over Time

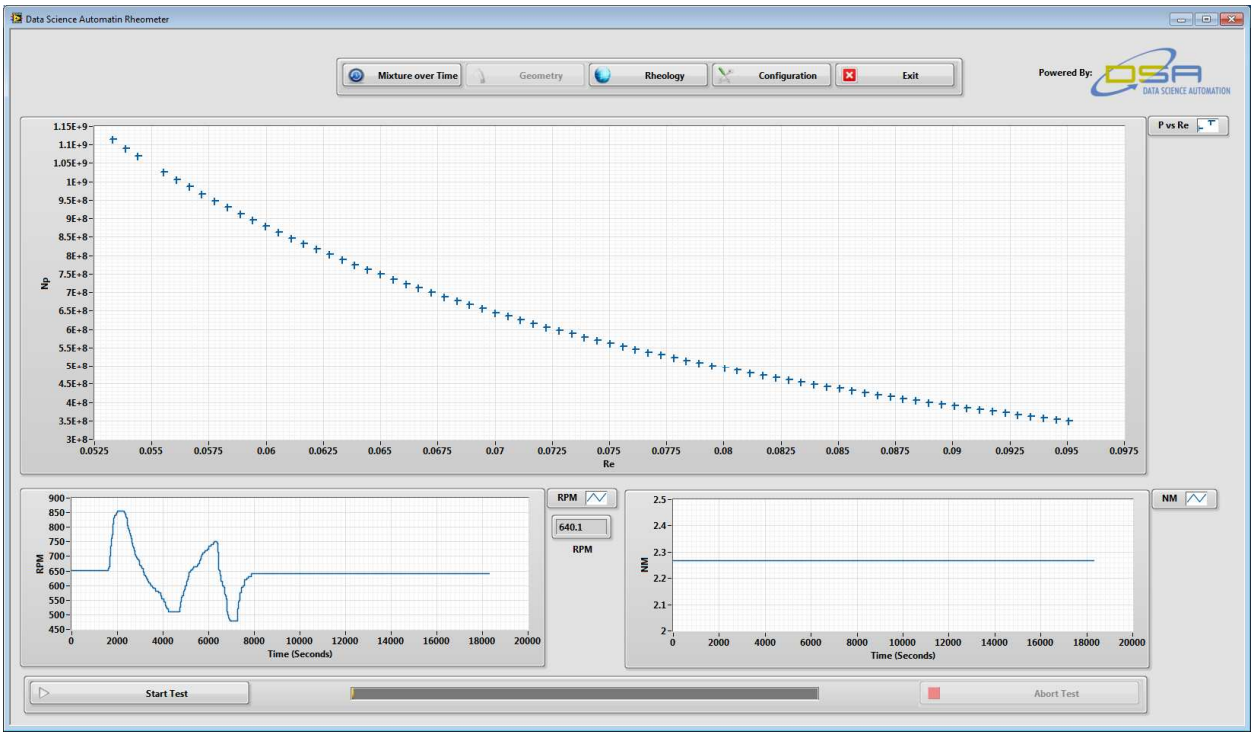

Figure 2-General Analysis