MODELA Computational fluid dynamics for the industry

The SAF-B Module

The **SAF-B Module** is a high-level monitoring and diagnostic tool designed for existing biogas plants. It provides a **"biological x-ray"** of your facility by synchronizing your manual field measurements with a high-fidelity **ADM1 engine**. By uploading your operational data, you unlock visibility into the invisible variables that dictate plant stability and performance.

Audience and Processes

This module is essential for **Plant Operators and Technical Consultants** who want to move beyond basic sensor readings to understand the underlying biological health of their system.

- **Primary Processes:** The module processes user-uploaded datasets (e.g., weekly lab results, daily biogas totals) to reconstruct the internal state of the digester, allowing for a deep-dive analysis of process resilience.

Functionality

- **Virtual Sensing (Soft-Sensors):** Using the uploaded data, the module calculates variables that are difficult or expensive to measure daily, such as specific **Volatile Fatty Acid** (VFA) profiles and the activity levels of methanogenic populations.
- **Anomaly & Issue Detection:** By comparing user-uploaded data against the **ADM1 predicted state**, the module highlights deviations that indicate early-stage acidification, ammonia inhibition, or mechanical mixing inefficiencies.
- **Predictive "What-If" Analysis:** Users can manually input hypothetical changes to the feed recipe or temperature to see how the system would react before making changes in the field.
- **Stability Scoring:** Generates a comprehensive **"Health Index"** based on the ratio of alkalinity to organic acids and other key stability indicators.

Usage: The Manual Sync Workflow

- **Data Upload:** The user uploads standardized data templates containing field measurements (e.g., pH, CH4, temperature, and loading rates).
- **State Synchronization:** The ADM1 engine processes the data to **"sync"** the digital twin with the current biological state of the physical plant.

- **Diagnostic Review:** The user reviews the generated report to identify hidden risks or opportunities for increasing organic loading without compromising stability.

Concepts and Assumptions: The ADM1 Observer

- **The Bridge:** It uses the **ADM1** as a mathematical observer. It assumes that the physical data provided by the user is sufficient to calibrate the model's internal state variables.
- **Steady-State vs. Dynamic:** While the model is dynamic, its accuracy depends on the frequency of user uploads; more frequent data points lead to a higher-resolution **"Digital Twin"**.
- **Biological Lag:** The model assumes standard biological response times for microbial growth and decay as defined in the ADM1 framework.

Benefits

- **Enhanced Resilience:** Identify biological stress—such as a rise in Propionic acid—days or weeks before traditional sensors trigger an alarm.
- **Operational Intelligence:** Understand why gas production is fluctuating, allowing for precise corrective actions rather than **"trial and error"** adjustments.
- **Risk Management:** Justify operational decisions to stakeholders with data-backed simulations, reducing the risk of a **"soured"** digester and the massive costs of a system restart.

infomodela@modela.co.uk

www.modela.co.uk