IDEAS Digital Twin in Process Industries

IMPROVING PULP M WITH DIGITAL TWIN

Since the 1980s, thanks to advances in computation technologies, computer-based simulation of processes using first principle models has become a well-known and widely used engineering tool for various industries. As our understanding of processes has increased, their representative models have become more realistic and sophisticated. The resulting improvement in accuracy has made simulation a fundamental predictive and diagnostic tool in process industries.

Accurate simulation can reduce engineering and construction costs, optimize process design, and improve operation performance by decreasing operation costs and increasing efficiency. In fact, simulation technology has become so advanced that it is now possible to simulate the interrelated processes of an entire pulp mill and connect these in real time to the mill's physical operation. These sophisticated first-principles based models are referred to as "Digital Twins."

DEFINING THE DIGITAL TWIN

The term Digital Twin was first introduced by NASA [1] in 2010 and quickly adopted by other industries. There is no official definition of Digital Twin as it relates to process industries; however, there are three important characteristics that are common across most descriptions of the term. Firstly, the simulation must be core to the functionality of the process. Secondly, the simulated process must follow the entire life cycle of the plant. And lastly, the simulation must be directly linked to the operation. Together, these three aspects create an intricate pairing between process and simulation – a Digital Twin.

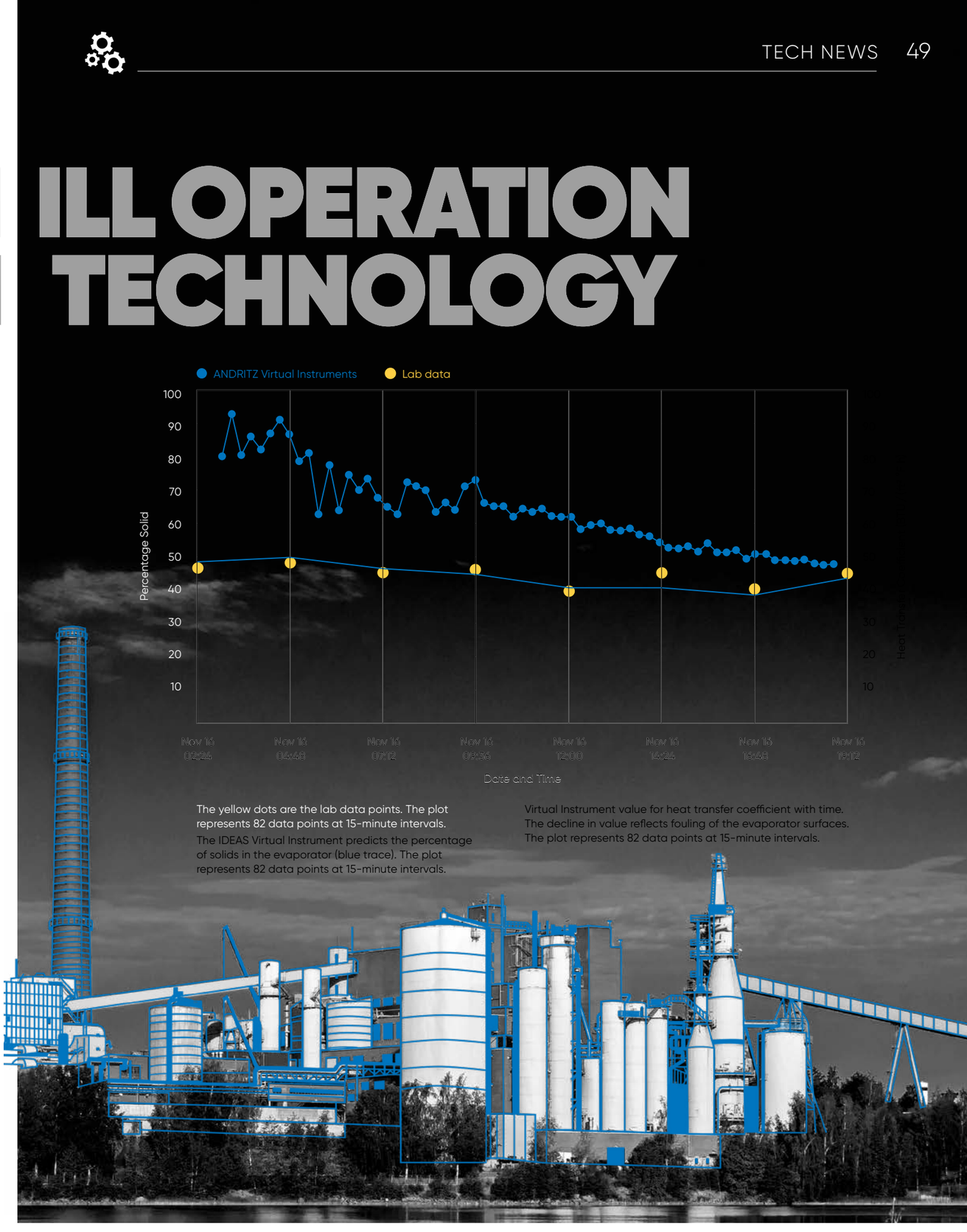
According to the industry research and trend analysis group Gartner, the concept of a Digital Twin is considered to be one of the most important disruptive technologies of 2018 [2]. As the internet and information technologies have been integrated into industrial operations, a new industry era known as Industry 4.0 (or the Industrial Internet of Things) has emerged. Digital Twins are a fundamental aspect of cyber-physical systems, which are one of the basic pillars of Industry 4.0, closely integrated with artificial intelligence and advanced analytics.

There are some major differences between a traditional simulation solution and a Digital Twin. In addition to being connected to an operational plant in real time, a true Digital Twin must run concurrent to the plant's operation, receive operation data in real time, process this data, and then generate valuable results in a timely manner. From a technical perspective, the combination of three components enables a true Digital Twin of processes to be formed: High-fidelity models, real-time connectivity to the operation being simulated, and a robust simulation environment.

THE MODELS MATTER MOST

High-fidelity models are at the heart of any Digital Twin solution. The term "fidelity" corresponds to how realistically the

ILL OPERATION TECHNOLOGY



The yellow dots are the lab data points. The plot represents 82 data points at 15-minute intervals.

The IDEAS Virtual Instrument predicts the percentage of solids in the evaporator (blue trace). The plot represents 82 data points at 15-minute intervals.

Virtual Instrument value for heat transfer coefficient with time. The decline in value reflects fouling of the evaporator surfaces. The plot represents 82 data points at 15-minute intervals.