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Short Communication

Predictive Maintenance for Injection Molding Industry

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Plastic injection molding is the third largest sector in manufacturing which warrants special consideration in the data Industrial Internet of Things as it impacts manufacturers and their customers. For instance, the plastic injection molding smart factory can efficiently use data for every process to begin preheating only when it has received data that the previous process is nearing completion.

Figure 1: Mold machine complements.
(https://www.ptonline.com/articles/another-oem-sees-predictive-maintenance-as-key-to-optimum-equipment-utilization)

Thereby, generating and maintaining the required level of heat to melt plastic can significantly reduce the amount of consumed energy. Consequently, the timing data communication between mold devices/processes is considered critical and should be not failed or delayed to reduce the cost of heating time and wasted energy that an injection mold device is sitting on standby. Moreover, increasing the production quality and stability is necessary for the condition of automation in the Industry 4.0/ Molding 4.0 environment [1].

The injection molding companies use the data provided by a mold monitoring system to plan for a scheduled predictive maintenance and aid the decision-making process for mold systems [2]. Accordingly, the molding companies need to perform real data analysis by capitalizing on the provided data from the mold production monitoring system. Besides performing online analysis, they use batch-based historical data analysis of production parts which highlights the previous common problems of mold systems during past intervals to provide early planning maintenance. Figure 1 shows the components of the molding machine which generate the molding data (e.g., temperature, humidity, vibrations). Furthermore, the molding data analysis needs to be performed on the powerful cloud computing infrastructure to meet the predictive maintenance requirements and cost demanded of injection mold manufacturing. Moreover, machine learning techniques are needed to make the decision model smarter based on reference molding data [3]. They can extract characteristics from the acquired data such as abnormality of mold tool characteristics including pressures, temperatures, and cycle count and then apply them to the decision-making model to early predict mold fault [4].

For accurate performing mold production, the injection mold manufacturers need high grantees of delivering and ordering consuming molding data to avoid over-heating mold devices using scalable queuing management technologies. These timely data should be analyzed within pre-defined regular intervals such as tumbling windows and sliding windows and then trigger the analytic results to the heating system within molding shop floor.

Also, the captured data during the molding process monitoring (i.e., gathered from sensors via a PLC) could be filtered, joined and summarized into averages and means to warn the decision-makers when the quality of the product may be lower than the defined standard. This situation can lead the decision-makers to investigate the reasons behind the lower quality which could be required early maintenance that overcomes future failures. In addition, the timestamp-based molding data such as log events including temperature deviations, sensor breakage, or downtime could be stored in high available document-based storage technology to send urgent alerts regarding operational issues or preventive maintenance even if there is a partial failure in mold device.

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