

TECHNICAL PAPER / 技術報導

Kottingbrunn/Austria – November 2018



Photo:

author / 照片來源: 作者

Fig.1: A condition monitoring system for condition-oriented scheduling of maintenance work increases plant availability in a demand-oriented “just-in-time” supply chain.

圖 1：狀態監測系統用於“面向狀態”的維護工作計劃，在面向需求的“即時”供應鏈中提高了工廠可用性。

CMS – keeping you informed about the condition of your machines

CMS (狀態監測系統) – 幫助您隨時了解機器狀況

CMS sensor systems for condition monitoring (CMS = condition monitoring system) have been in use in large-scale production plants for many years to minimize profit losses through production downtimes and costly maintenance work. Application examples are rotary kilns in cement plants, conveying systems in mining, pipe-jacking machines in tunnel construction, power plant turbines or wind power stations. Thanks to recent progress in sensor technology and increasing availability of high-speed data networks, CMS systems are now becoming interesting also for less expensive capital goods such as injection molding machines. Here, Wittmann Battenfeld has blazed the trail and offers CMS equipment as an optional extra for its injection molding machines.

用於狀態監測的 CMS 傳感器系統 (CMS = 狀態監測系統) 已經在大型生產工廠中使用多年，大幅減少生產停工和昂貴的維護工作而達到最小化的利潤損失。應用實例包括水泥廠中的迴轉窯，採礦中的輸送系統，隧道施工中的頂管掘進機，發電廠渦輪機或風力發電站。由於傳感器技術的最新進展和高速數據網絡的可用性的增加，CMS 系統現在也因可用性增加，也適用於諸如射出機之類的較便宜的資本設備。在這裡，Wittmann Battenfeld 開闢了道路，並為其射出機提供 CMS 設備作為可選配置。

In contrast to time-oriented maintenance (preventive maintenance), where machine parts are replaced at fixed intervals regardless of their actual condition, condition monitoring (CM) is based on continuous observation of the parts' condition (predictive maintenance). The latter approach offers the advantage that replacements depend exclusively on the actual degree of wear and functionality of the parts. The superiority of condition monitoring over preventive maintenance is inherent in the method itself. For any damage occurring in the course of a maintenance interval normally remains undetected and may therefore even lead to a total breakdown, while the problem could often be remedied at little expense if it was detected in time. The costs for unplanned repairs incurred in this way and the loss of profit caused by the machine standstill are generally higher than the costs of a condition monitoring system. This is all the more important; the more closely the production is linked to a just-in-time supply chain, as is the case, for example, in injection molding production for automotive suppliers. (fig.1)

與時間導向維護（預防性維護）相比，狀態監測（CM）是基於對部件狀況的連續觀察（預測性維護），無論實際情況如何，機器部件都以固定間隔進行更換。後一種方法提供的優點是，更換完全取決於零件的實際磨損程度和功能性，因此狀態監測優於預防性維護是該方法本身所固有的。對於在維護間隔期間發生的任何損壞，通常仍然未被檢測到，因此甚至可能導致完全故障，而如果及時檢測到該問題通常可以以很少的費用來補救。以這種方式發生的計劃外維修的成本和機器停機造成的利潤損失通常高於狀態監測系統的成本。特別是對於生產與準時供應鏈聯繫越緊密的產業，例如汽車供應商的注塑生產。（圖 1）

Comprehensive CMS package available 提供全面化的 CMS 組合

At the K 2016, WITTMANN BATTENFELD introduced a condition monitoring system (CMS) which is available as an optional equipment package for injection molding machines. It accesses the values measured by already existing as well as additional sensors installed for this purpose and passes on these data to a recording system.

在 K 2016 展會上，威猛巴頓菲爾推出了一款狀態監測系統（CMS），可作為注塑機的可選配配置包。用以訪問已經存在的以及為此目的安裝的附加傳感器所測量的值，並將這些數據傳遞給記錄系統。

The CMS system actually monitors the following (fig. 2):

CMS 系統實際監控以下內容（圖 2）：

- in (servo-) hydraulic machines, the drive function of the hydraulic system (vibrations in the pump drive, current consumption, system pressure),
在（伺服）液壓機中，液壓系統的驅動功能（泵驅動器中的振動，電流消耗，系統壓力）
- in (servo-) hydraulic machines, the quality of the oil (temperature, number of particles in the oil and water content), in all-electric machines, the quality of the gear oil
在（伺服）液壓機中，油的質量（溫度，油中顆粒數和水含量），全電機，齒輪油的質量
- the “climate” inside the electric cabinet (temperature, moisture, possible smoke formation),
電櫃內的“氣候”（溫度，濕度，可能形成的煙霧）
- the capacity of cooling water and air supply (flow quantity, pressure, temperature),
冷卻水和空氣供應能力（流量，壓力，溫度），
- the mechanical parameters of the clamping unit (pressures in the pads of *MacroPower* machines, vibrations and torques in servo-electric drives),
鎖模單元的機械參數（*MacroPower* 機器的焊盤壓力，伺服電機驅動器的振動和扭矩），

- the mechanical parameters of the plasticizing/injection unit (vibration, plasticizing torque, screw stroke, closing behavior of the check valve). One cause of vibration may be a loose screw in the screw coupling which, if it remains unnoticed, may lead to major consequential damage. (fig.3)

塑化/注射裝置的機械參數（振動，塑化扭矩，螺桿行程，止回閥的關閉行為）。振動的一個原因可能是螺釘聯接器中的鬆動螺釘，如果它仍然未被注意，可能導致嚴重的後續損壞。（圖3）

Condition data processing on three levels 條件數據處理的三個級別

1. Measurement data collection and display on the machine

在機器上採集並顯示測量數據

The data (temperatures, moisture, signals from the smoke detector inside the electric cabinet) are collected on the machine partly cycle-synchronously and partly dependent on time, and subsequently transmitted to the CMS computer for evaluation. On the machine, the current condition data are displayed compactly on an overview page of the machine's B8 control system (fig.4). Deviations from pre-set reference values (temperature ranges, air pressure, and smoke detector signals) are visualized by green/red traffic light indicators.

在機器上部分循環同步的收集數據（溫度，濕度，來自電櫃內的煙霧探測器的信號），部分取決於時間，並且隨後被傳輸到 CMS 計算機以進行評估。在機器上，當前狀態數據緊湊地顯示在機器 B8 控制系統的概覽頁面上（圖 4）。通過綠色/紅色交通燈指示器可視化與預設參考值（溫度範圍，氣壓和煙霧探測器信號）的偏差。

2. Data analysis and processing on the CMS host computer

CMS 主機上的數據分析和處理

The heart of the CMS system is the CMS computer. It is part of a production control system. It communicates with the injection molding machines and draws the measurement data, collects and saves them for possible later backtracking. The CMS software processes the measurement data into trend-tracking models.

A CMS control station is able to monitor up to 50 machines simultaneously and pass on advance warnings to maintenance staff by email (fig.5).

CMS系統的核心是CMS計算機。它是生產控制系統的一部分。它與注塑機通信並繪製測量數據，收集並保存測量數據，以便以後進行回溯。CMS軟件將測量數據處理為趨勢跟踪模型。

CMS控制站能夠同時監控多達50台機器，並通過電子郵件將預先警告傳遞給維護人員（圖5）。

3. Data evaluation and condition analysis

數據評估和狀態分析

Evaluation of the data is based on generally recognized quality standards, such as the NAS (National Aerospace Standard) oil quality assessment 1638 or the oil purity rating according to ISO-4406. Empirical limit values are used for judging air and oil pressure values, temperatures or the closing behavior of the check valve. In addition, the vibrations of components exposed to wear are measured by vibration sensors and evaluated by analysis algorithms (see again fig. 2).

對數據的評估基於公認的質量標準，例如NAS（國家航空航天標準）油質量評估1638或根據ISO-4406的油純度等級。經驗極限值用於判斷空氣和油壓值，溫度或止回閥的關閉行為。此外，暴露於磨損的部件的振動由振動傳感器測量並通過分析算法評估（再次參見圖2）。

Besides current status information, the CMS software also delivers trends indicating changes in functional values. These provide the basis for decision-making by maintenance staff. Should no sufficiently qualified or experienced personnel be available on site for correct interpretation of this decision-making tool, it is also possible to outsource the interpretation of the data to a WITTMANN

BATTENFELD service center via online networking and have the necessary maintenance work initiated from there. This service can be supplied by the WITTMANN BATTENFELD service organization (fig.5).

除了當前的狀態信息，CMS軟件還提供指示功能值變化的趨勢。這些為維護人員的決策提供了基礎。如果現場沒有足夠的合格或有經驗的人員來對此決策工具做出正確解釋，也可以通過在線網絡將數據解釋外包給威猛巴頓菲爾服務中心，並從那裡開始必要的維護工作。該服務可由威猛巴頓菲爾服務機構提供（圖5）。

Summary 總結

Condition-oriented machine maintenance offers better failure protection than servicing in fixed regular intervals or a preventive maintenance concept since, due to lack of information, malfunctions developing between maintenance sessions (loose screws, gradual failure of bearings) with a risk of sudden total breakdown are very hard to detect. This is why a CMS system is a useful contribution to improving failure protection of production processes, primarily and in particular for just-in-time production chains. The cost of implementing a condition monitoring system is already compensated for by preventing only a few days of production standstill.

與固定的定期間隔或預防性維護概念相比，以狀態為導向的機器維護提供了更好的故障保護。由於缺乏信息，在維護期間（螺釘鬆動，軸承逐漸失效）之間出現故障，並且存在突然完全故障的風險很難察覺。這就是為什麼 CMS 系統對改善生產過程的失效保護有用的原因，特別是對於即時生產鏈而言。實施狀態監測系統的成本，透過防止生產停滯的損失中即可得到補償。



Illustrations 插圖:

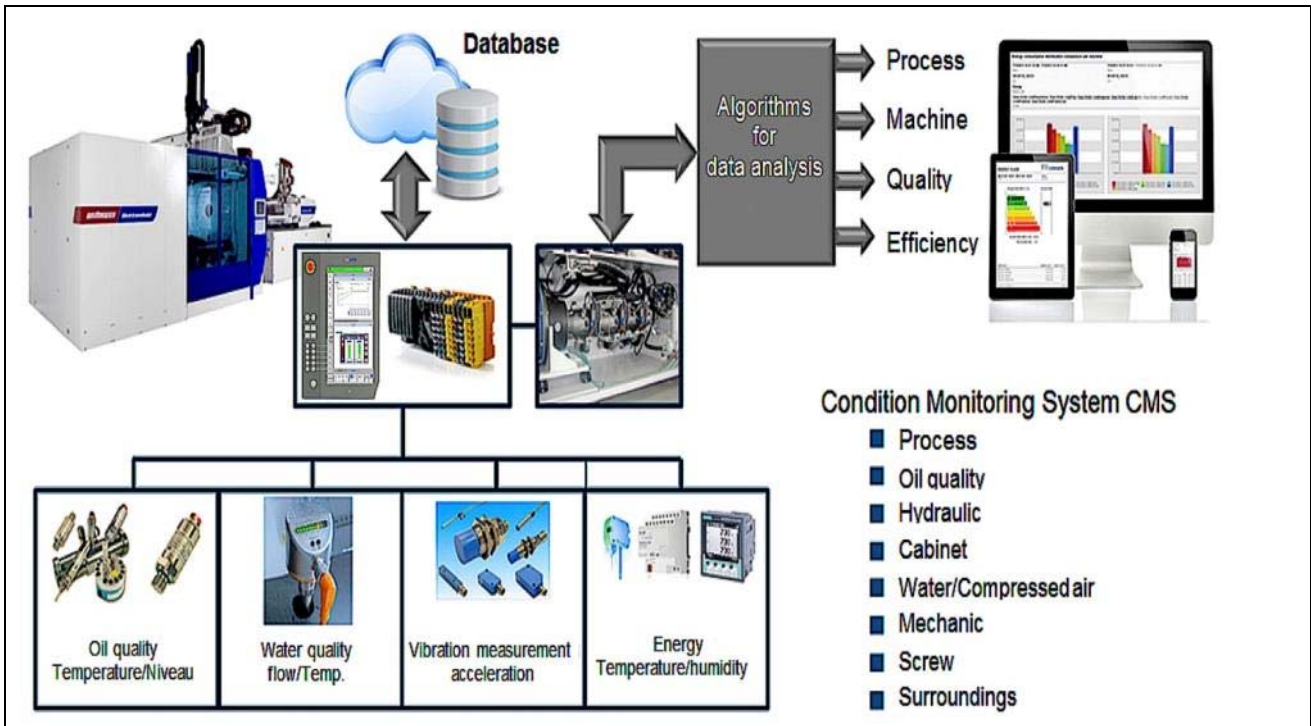


Image 圖片: WITTmann BATTENFELD 威猛巴頓菲爾

Fig. 2: The WITTmann BATTENFELD CMS concept of condition data collection by sensors and subsequent data processing as the decision-making basis for maintenance work

圖 2: 威猛巴頓菲爾 CMS 通過傳感器和後續數據處理收集狀態數據的概念，作為維護工作的決策依據

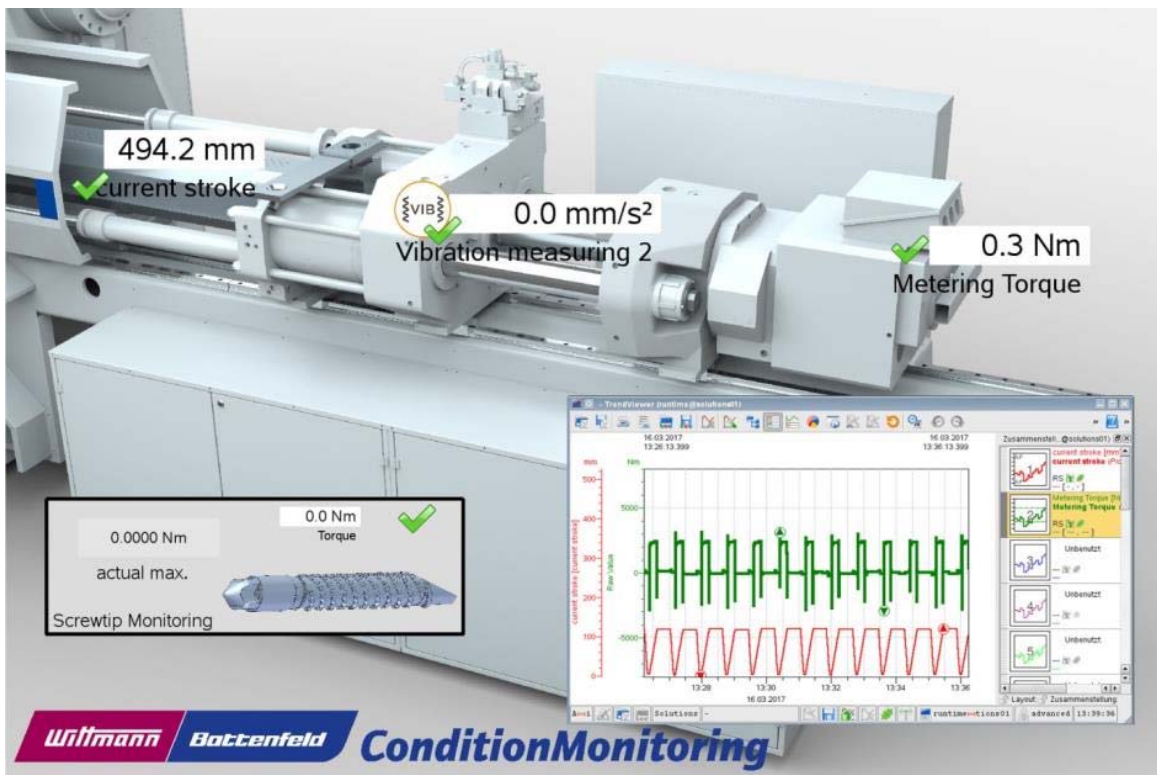
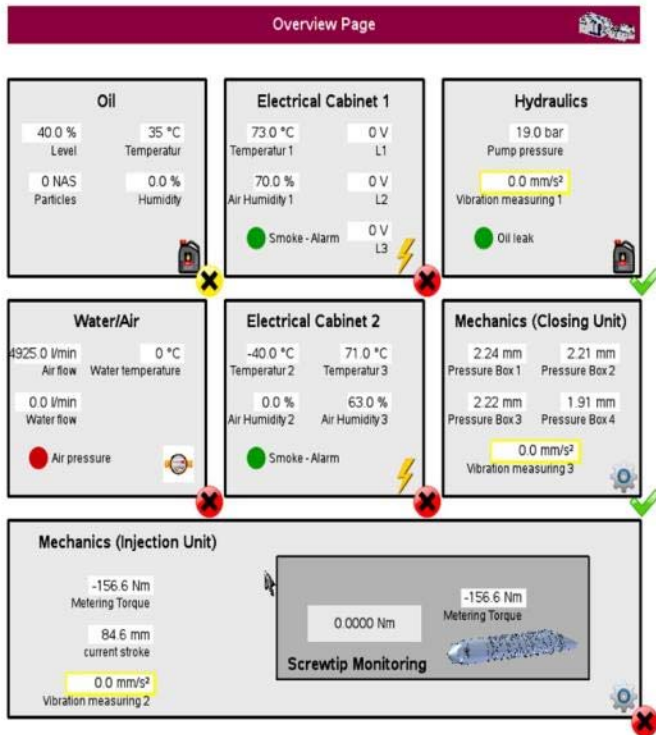


Image 圖片: WITTmann BATTENFELD 威猛巴頓菲爾

Fig.3: Display example of condition monitoring of the screw drive and check valve function

圖 3: 螺桿傳動和止回閥功能狀態監測的顯示示例



Image

圖片: WITTMANN BATTENFELD

Fig.4: Overview of condition values on the B8 machine control system

圖 4：B8 機器控制系統的狀態值總覽

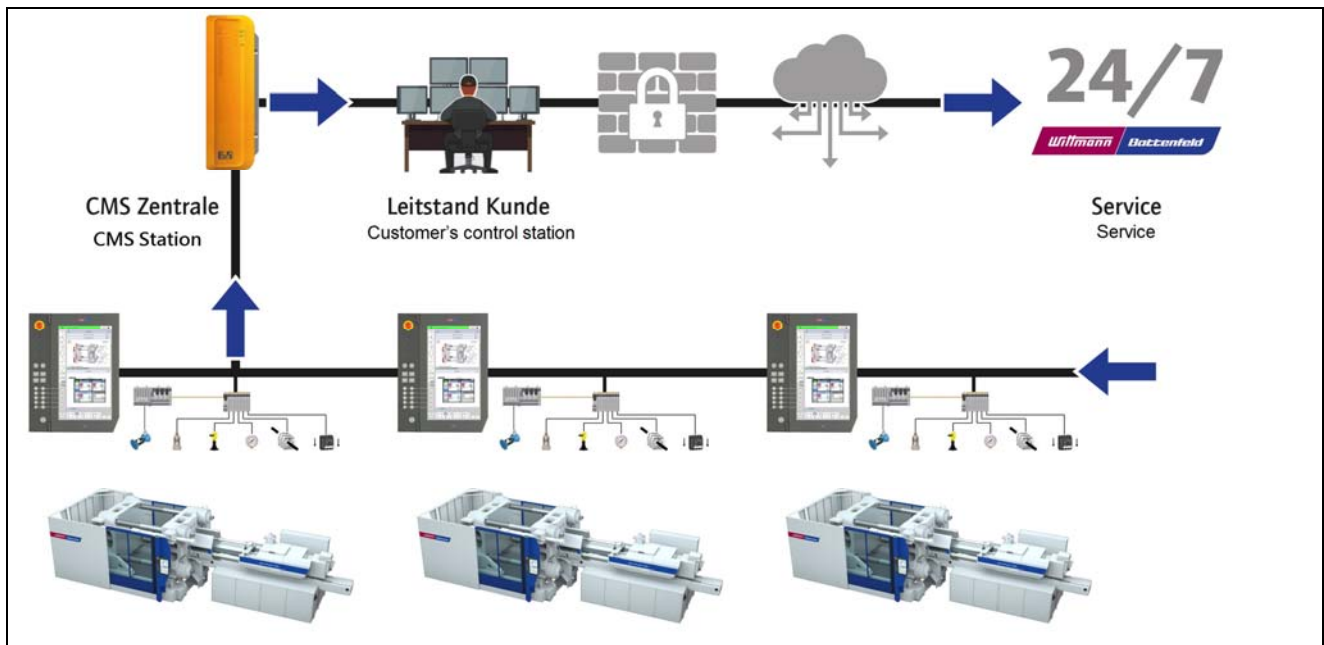


Image 圖片: WITTMANN BATTENFELD

Fig.5: The monitoring data from up to 50 machines can be collected on one condition monitoring host computer. Where the measured values exceed or fall below tolerance margins, the calculated data trends trigger signals which must be correctly interpreted and followed up by appropriate action on the part of qualified maintenance staff.

圖 5：可以在一台狀態監測主機上收集多達 50 台機器的監控數據。當測量值超過或低於公差範圍時，計算的數據趨勢觸發信號必須正確解釋並由合格的維護人員採取適當的措施。

About WITTMANN BATTENFELD

WITTMANN BATTENFELD is a member company of the WITTMANN Group with its headquarters and production plant located in Kottlingbrunn / Lower Austria. Its corporate focus is on plastics injection molding technology, covering the entire range of machinery from micro injection molding machines with 5 tons clamping force up to large machines with 2,000 tons clamping force. The company's product portfolio is rounded off by extensive additional technology packages, e.g. for multi-component, foam or fiber composite injection molding. In conjunction with the portfolio of the WITTMANN Group, a leading manufacturer of robotics and auxiliary equipment for material supply, WITTMANN BATTENFELD is able to supply complete injection molding systems including Industry 4.0 data networks.

WITTMANN BATTENFELD 是威猛集團的成員公司，其總部和生產工廠位於 Kottlingbrunn / Austria。其公司專注於塑料注塑技術，涵蓋從 5 噸鎖模力的微型注塑機到具有 2,000 噸鎖模力的大型機器的整個機械系列。該公司的產品組合通過廣泛的附加配備方案，例如，用於多成分射出，泡沫或纖維複合射出。WITTMANN BATTENFELD 與機械和材料供應輔助設備的領先製造商威猛集團的產品組合相結合，能夠提供完整的射出系統，包括工業 4.0 數據網絡。

The WITTMANN Group

The WITTMANN Group is a worldwide leader in the production of injection molding machines, robots and peripheral equipment for the plastics processing industry, headquartered in Vienna/Austria and consisting of two main divisions: WITTMANN BATTENFELD and WITTMANN. They jointly operate the companies of the group with eight production plants in five countries, and its additional sales and service companies are active with 34 facilities on all important plastics markets around the world.

WITTMANN BATTENFELD pursues the further expansion of its market position as an injection molding machine manufacturer and specialist for state-of-the-art process technologies. As a supplier of comprehensive, modern machine technology in modular design, the company meets both present and future market demands for plastics injection molding equipment.

The WITTMANN product portfolio includes robots and automation systems, material handling systems, dryers, gravimetric and volumetric blenders, granulators, temperature controllers and chillers. With this diversified range of peripheral units, WITTMANN offers plastics processors solutions to cover all production requirements, ranging from independent production cells to integrated plant-wide systems.

The syndication of the various segments under the umbrella of the WITTMANN Group has led to complete connectivity between the various product lines, for the benefit of plastics processors with an increasing demand for seamless integration of processing machinery with automation and peripherals.

威猛集團

威猛集團是塑料行業中製造射出機、機械手和周邊設備的全球領航者。威猛集團總部設在維也納/奧地利，由兩個主要部門，威猛巴頓和威猛組成，他們共同經營集團旗下分公司，在全球 5 個國家設有 8 個生產工廠，其中超過 34 個直屬子公司位於世界各大塑料市場，並各自負責該區域的銷售及售後服務。

威猛巴頓致力於製造最先進的射出機和工藝技術的獨立市場增長，提供現代化和全面的機械模組化設計，滿足塑料射出成型的實際和未來要求。

威猛的產品系列包括機械手和自動化系統，中央供料系統，除濕乾燥機，秤重式和體積式的計量機，粉碎機，模具溫度控制器和冷卻器。憑藉這種全面的周邊設備，威猛可為塑料加工商提供涵蓋所有生產要求的解決方案，從自主工作單元到整個工廠範圍的系統。

威猛集團的結合已經使所有產品線連接為一體，提供塑料加工商在射出機、自動化和輔助設備的無縫接軌，為塑料加工廠帶來了益處，對加工機械與自動化和外圍設備的無縫集成日益增長。

更多信息可參訪我們的網站 www.wittmann-group.tw