

## People and Machines Working Side by Side – Robot Operation for Injection Moulds

The coordinated teamwork of people and robots on a fixed workpiece pallet always poses a challenge for a system integrator. He must find the optimal combination for the application consisting of the optimal robot operating speed and protective measures for the worker.

One such challenge was the implementation of partial automation for the manufacture of injection moulding components at MKG GmbH & Co. KG in Lotte near Osnabrück. In the course of a comprehensive upgrade of this manufacturing step, the filling of the injection moulds mounted on the workpiece pallets is to be taken over by industrial robots, while the emptying, cleaning and provision of the moulds will continue to be done manually.



Together with its customer, de Man GmbH in Borgholzhausen developed an integrated concept that offers the worker who interfaces with the robot optimal protection within the scope of legal safety provisions.

The focal point of the application is a KUKA KR125 robot. Surrounding the robot on each of three sides are five stations for the workpiece pallet, on which the injection moulds are mounted. Each of these sides constitutes a section in the installation. On the fourth side there is a high-pressure machine that provides the filling mixture. Due to the large dimensions of the installation, the robot is equipped with an additional arm extension measuring about one meter (3 feet). The worker's workspace is located outside of the mould block, so that the mould carriers form the intersecting point between people and the machine. In order to guarantee the safety of the worker, two 5x2 meter (15x6 ft) fence elements, which open in the upwards direction and block the access to the robot reciprocally were provided for in each section.

While the worker prepares the injection moulds of one section, the fence element blocks any unauthorized access on the part of the worker behind the moulds. If he clears the section for filling, the element is automatically pulled upward, so that the robot can reach the moulds. At the same time, the second element is lowered directly in front of the worker, thus again blocking off the interior.

To fill the moulds, the robot moves a filling head, which is connected to the high-pressure machine via hoses, over the filler of the moulds and fills it. In doing so, the robot accesses a comprehensive database that provides necessary data such as the number and coordinates of the fillers for the moulds to be filled, the coordinates of the closers, the filling quantity and the response time of the mixture per mould. After each mould is filled, the robot closes the filler automatically; at the same time an internal counter starts that allows the response time specified for this mould to expire. If all moulds are filled, the section rests until the last counter has reached its runtime. Then the section automatically reopens for the worker, with the outer fence element being raised upward thus enabling manual access to the mould carrier. At the same time, the inner element closes and the moulds are unlocked. The worker removes the ready pieces, cleans the moulds and prepares them to be filled again.

Because there are three sections in the installation, a continuous cycle is created whereby one section is prepared by a worker, one is being filled and one is at rest. A cycle is optimized in which moulds that have similar response times are combined per section.

Die MKG GmbH & Co. KG currently has about 100 various active injection moulds. During a product change, the corresponding mould carrier is removed from the block by means of a manual forklift. After the carrier is reintegrated, the coordinates of all fillers and clamps are tightened and saved in the teach-in process by the worker. This makes you independent of the type of mould, the location of the carrier in the block and its exact alignment.

The Technical Director of MKG GmbH & Co. KG was quite impressed by the robots: “The rationalization measures we calculated are showing great advantage. Through improved labour utilisation, shorter preparation times and an increase in output we will achieve a payback period of 15 months for the installation. This will make it possible for us to document and assess the performance of this manufacturing area for the first time.

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