

Quadra, 74130 Contamines-sur-Arve, France

Production line for the manufacture of slats and beams for pig farming installed in the US

Midwest Dry Cast, based in Luverne, Minnesota, is specialized in the manufacture of concrete products suitable for pig farms, like slats and beams. This young US company wanted to evolve into an industry of the future and decided to industrialize its production. As a partner for this project the management chose the leading international manufacturer of machinery for the production of concrete products Quadra. Quadra delivered a plant that meets the high expectations of Midwest in terms of productivity and product quality thanks to maximum automation and a fast mold change system.

Founded in 2017, Midwest Dry Cast company, based in the United States, is specialized in the prefabrication of concrete components for the livestock market. Established in Luverne, Minnesota, the company is made up of a local team of enthusiasts with experience in the farming industry and in building barns - a winning combination of skills. It is from this experience that this young company has acquired expertise to develop innovative concrete products suitable for pig farms and thus to stand out with high-quality achievements.

To industrialize production, the choice of a partner was essential and risky for the company. For Midwest Dry Cast, this production unit project was born out of a desire to evolve into an industry of the future. In addition to productivity criteria and product quality, this plant was part of a global process of improvement and progress. This is how operators' health and safety and environmental criteria were taken into account in the development of the project.

The equation posed by Midwest had to be solved with technical solutions, some proven, some others unprecedented. Ultimately, the project developed by Quadra was convincing and its advantages were decisive:

- A fully automated production and storage process,
- the elimination of painful tasks for operators,
- a quick change of molds assisted by remote control units,
- optimal safety conditions for operators with drastic reduction in handling and forklift traffic (reduced risk of accidents),



Midwest Dry Cast plant, Minnesota

- particularly efficient industrial production rate and high-end product quality:
 - an average rate of twelve to 15 pallets/hour depending on slat dimensions;
 - 6,400 mm/1,520 mm (21"/5") pallets size for 6,200 mm/1,300 mm drop.

This production rate may appear in contradiction with product quality. In fact, to manufacture a high strength, aesthetic and precise product, it takes a while which could reduce the production rate.

To harmonize this paradox, the equipment provided by Quadra presents an innovative feature: the ability to perform manufacturing operations of the product at the same time at different workstation.

An innovative concept

The kinematics of the plant allows to use two molds at the same time. An automatic mold handling and movement system positions one mold at the manufacturing workstation while the other is installed at the finishing workstation. The following operations are carried out at the manufacturing workstation - placement of reinforcements, concrete filling and vibro compaction. While the following actions are happening at the finishing workstation - trowelling, demolding, and quality control. The production cycle is split into two phases of similar duration.

Fully automated, this production line requires only three operators to run. Thus, the time chosen and necessary to carry out each operation of the manufacturing cycle ensures the consistency and the care required to obtain quality, which results in an increase of productivity of at least 30 % compared to traditional machines.

Manufacturing workstation

The mold is placed with accuracy at the filling workstation. Located at the filling workstation, a gantry, equipped with pneumatic clamps, collects the steel reinforcement, and moves transversely in the direction of the mold. The gantry is then positioned just above the mold and inserts the reinforcement with accuracy and speed into the mold. Once the reinforcements are in place in the mold, the rebar trolley frees the space to allow the concrete filling device to come into action. A concrete hopper, discharged via a conveyor belt, continuously supplies the feeding box. Concrete level in the hopper is displayed on the dialogue screen and settings are made directly from the control panel.

The cylindrical feeding box contains a rotating propeller driven by an electric motor to fill quickly and homogeneously the mold with concrete. The filling operation is carried out

by the simultaneous action of the propeller rotation and the translation movement of the feeding box along the length of the mold. Adjustable rotation and translation speeds of the feeding box enable efficient concrete filling of the mold. In order to obtain a constant level, a continuous control of the concrete feed into the feeding box is carried out by laser sensor.

During this filling phase, the mold located on vibrating trestles is subjected to vibratory agitations, whose amplitude and frequency are adjustable.

Transfer of the two molds

The mold transfer system is located between the manufacturing station and the finishing station. The goal is to obtain a very fast and precise mold exchange. The full mold moves to the lower position while the empty mold moves to the upper position.

When the molding operation is completed for mold No. 1 at the manufacturing station, i.e. the mold is filled, mold No. 2 that is returning to the finishing station is empty. In this phase of the operating cycle, the automatic simultaneous change of positions of the two molds is started.



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Steel reinforcement is automatically placed into the empty mold

When mold No. 2 is empty, it is moved to a location for the automatic oiling operation before taking the free location at the manufacturing station and mold No. 1, full of concrete, is transferred to the finishing station. At this stage of the cycle, the manufacturing time for a mold is over - in this example for mold No. 1; the finishing operations that now still have to be carried out on mold No. 1 are a separate process that runs independently of the general production process and do not interrupt it.

With this mode of operation, the productivity gain is at least + 30 % compared to conventional machines.

Finishing operation by troweling and demolding

Mold No. 1 is positioned in reference on a table. A tool carriage moves over the already filled mold to moisten the concrete surface. Then, a finishing carriage supporting a surfacing disc proceeds to trowel the concrete surface. This large-diameter, abrasion-resistant steel disc is pressed against the mold and controlled in rotation by an electric motor controlled by a frequency inverter.

All parameters, movement speed, rotation speed and plating force of the disc, all necessary to obtain a high quality of finish, are adjustable and can be memorized. Once the finishing operation is completed, the product surface is smooth and the top of the mold is clean.



Manufacturing workstation

The demolding operation can then begin. An automatic bridge crane brings an empty pallet and clamps it over the mold. The crane picks up the assembly and turns the mold and pallet by 180° while simultaneously moving to the demolding location. Once at standstill, the crane places the pallet on a support and gently lifts the mold to carry out the demolding. The empty mold is then brought back to the vibration station to start the next manufacturing cycle. This handling system is designed to allow very short cycle times.

Handling by automatic overhead crane

A metal structure has two overhead crane runways on which an automatic crane moves to ensure the storage of fresh products in the curing chambers and the movement of dry products to the palletizing station.

Once a stack of pallets is complete, the overhead crane places a lid on top and the automatic system informs the curing chamber PLC that the steam drying process for this stack can begin.

The automated management of the steaming area allows the zone to be organized by order of product entry to guarantee a precise and rigorous drying time.

This system makes it possible to know exactly where the products are located in the curing chamber, and to proceed with

Finishing workstation



Demolding process

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Handling by automatic overhead crane



Curing area

the handling of the products once they are completely dry. The automatic storage overhead crane has the advantage of not involving any manual handling. The design of this storage system takes into account the technical constraints related to the existing buildings, the types of products to be handled, as well as the management of flows in the workshop.

Packaging of finished products

An automatic crane moving on two overhead crane runways is dedicated to palletizing the finished products. It is equipped with a clamp with adjustable clamping according to the size of the products (slats or beams). This gripper has a turning function to pack the slats in the right direction and stack them horizontally. Once released, demolding pallets are automatically transferred to a cleaning station. A scraper

and an oiling ramp are used to prepare the pallet before it is returned to the line for reuse.

Plant supervision

Fully automated, the supplied production unit is supervised by three operators at the manufacturing station, the quality control, and the removal of finished pallets.

A secure quality control station is located after the demolding station and allows the operator to check the fresh products. Located in a secure area, the operator in charge of placing the steel reinforcement in a jig can take the time needed while the machine is running in automatic mode. Working and safety conditions have been taken into account and mark a significant evolution.



Palletizing and packaging station



The machine is managed by a PLC, whose interface allows the operator by means of a touch screen to set and visualize all manufacturing parameters easily and quickly. The operator thus becomes the supervisor of the whole process. The control software - modern and complete - is fully developed by Quadra.

Conclusion: A successful first collaboration

Established in Phoenix, since 2017 with its subsidiary Quadra USA Inc., Quadra has surrounded itself with an experienced commercial and technical team to serve directly on the North American territories. Directly managed from the United States, this subsidiary allows Quadra to be reactive to meet customer demands, to have a stock of spare parts available on the continent and thus to provide follow-up, technical assistance and local customer service.

As a global manufacturer, Quadra designed, manufactured, assembled and tested the equipment in its workshops located in France prior to shipment. Then on the customer's site, assembly, commissioning and operator training operations continued until final acceptance.

Quadra was able to provide a tailor-made solution to meet Midwest Dry Cast's manufacturing requirements and needs. The facility delivered even higher than originally planned production rates. The efficiency of the new process (automation and high throughput), the flexibility offered by the tool-

ing as well as the quality of the products manufactured are a true success.

After the first shipments in early 2019, Midwest does not stop there. Despite the effects of COVID, the company aims to double its production volume. This first collaboration between the two companies is a success. ■

FURTHER INFORMATION



Midwest Dry Cast
 1281 101st Street, PO Box 804
 Luverne, MN 56156, USA
 T +1 507 935 5555
aaron.w@midwestdrycast.com
www.midwestdrycast.com



Quadra
 40, route de Findrol
 74130 Contamines-sur-Arve, France
 T +33 450039221
info@quadra-concrete.com
www.quadra-concrete.com



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