

The Nozzle Operator

Content:

- Concrete technology
- Spraying equipment
- Designer expectations
- Sprayed concrete application
- Surface finishing and curing
- Standards and testing
- Health, safety & environment



Spraying equipment

Robotic application of wet sprayed concrete



Advantages

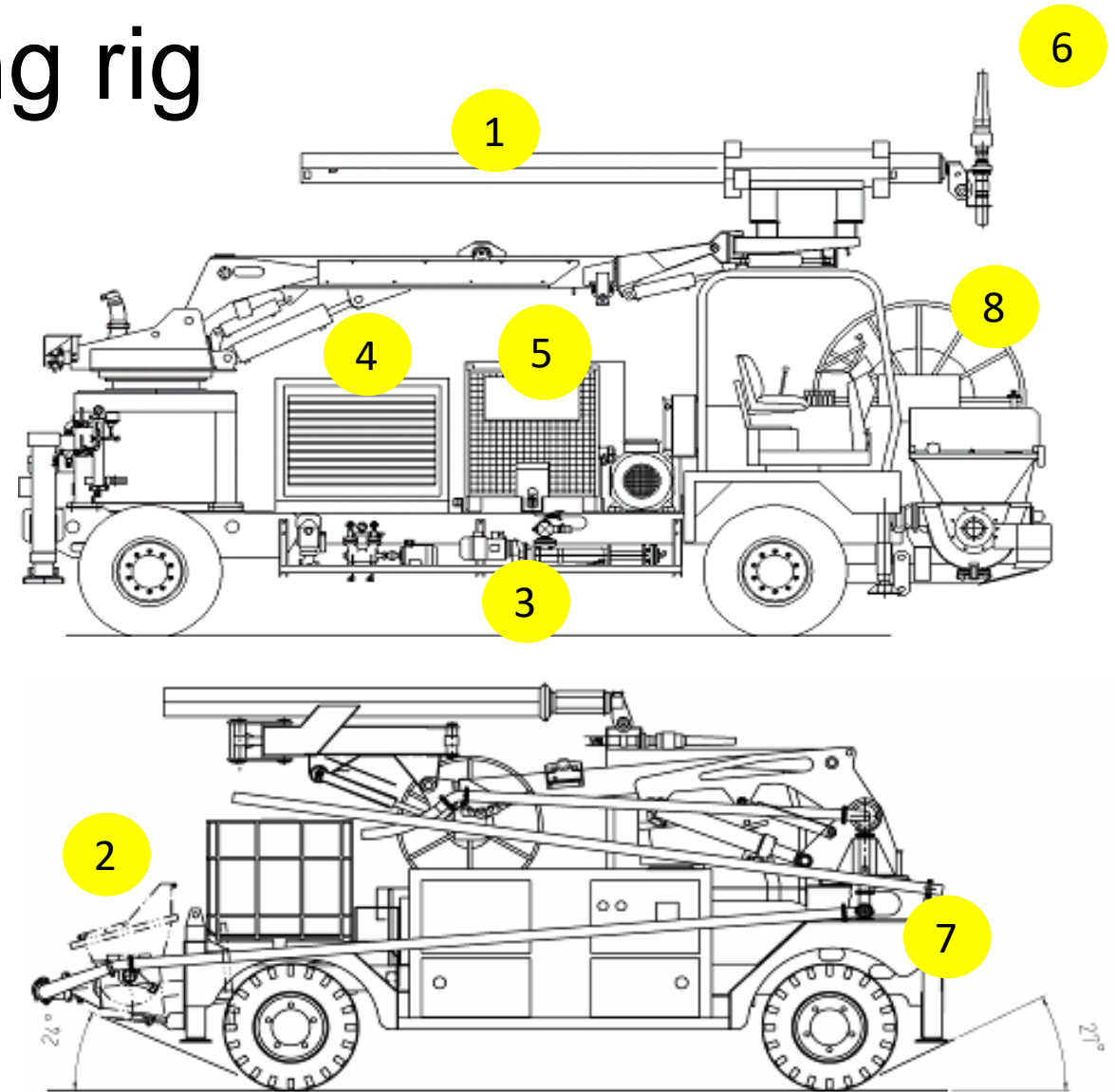
- Increased safety and outputs up to 30 m³/h
- Good compaction
- Even, smooth finishing
- Low rebound < 10%
- No need for lifting platforms
- QC in the RMP, not at the nozzle
- Low dust generation
- Fully robotic
- Attractive overall cost

→ A robotic application ensures higher quality and durable sprayed concrete



The set-up of a spraying rig

1. Spraying manipulator
 2. Concrete pump
 3. Dosing system
 4. Air compressor
 5. Set accelerator storage tank
 6. Concrete line
 7. Carrier chassis 4WD
 8. EH Power pack + high voltage cable
- Working lights
 - Auxiliary systems for cleaning and maintenance



Remote control

Electro-Hydraulic control system with **remote control** of operation of all main functions:

- Accelerator dosing rate (%)
- Concrete pumping output (m³/h)
- Air flow output (m³/min)
- Water flow for wall washing (l/min)

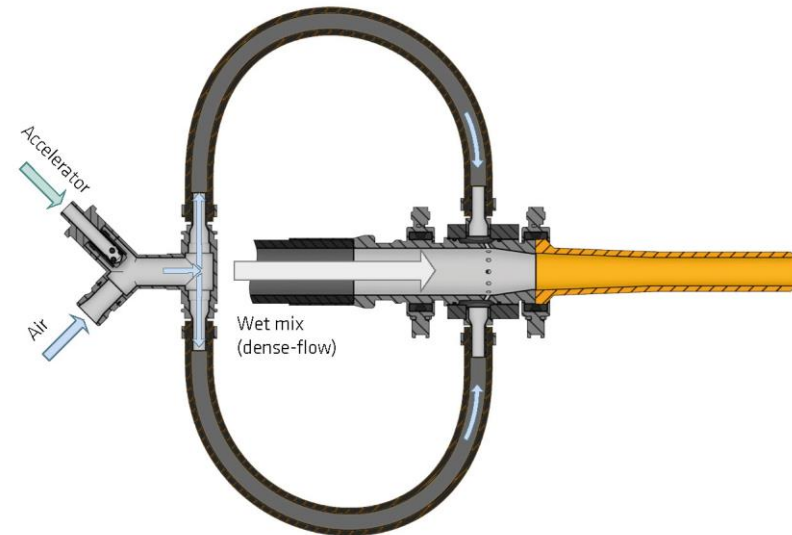
Boom with lance and a parallel compensation system of the spraying lance



The spraying head

At the spraying head and nozzle the set accelerator is introduced with compressed air into the concrete line via injector piece

The spraying head with hydraulic oscillating motors allows all necessary movements for improved homogeneity of the sprayed concrete



The concrete pump

The concrete pump with a double piston system designed for spraying concrete to 20-30 m³/h nominal capacity in normal production in a tunnel

Practical max peak spraying capacity of a skilled operator is about 25 m³/hour

Bigger concrete cylinders means fewer strokes and more homogenous final structure



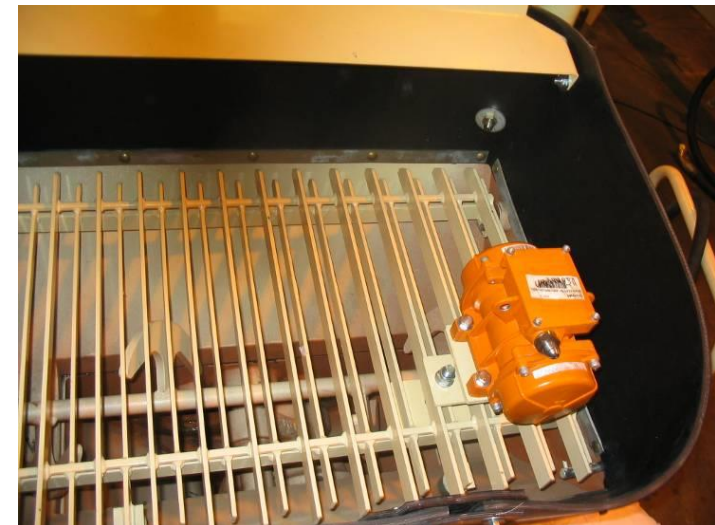
Concrete feed at the hopper

An agitator is needed to prevent segregation and help flow of concrete to the cylinders during pumping with a good filling cover to minimize pulsation effect



The grid is used to prevent large items entering the lines and causing damage and blockage

A vibration unit is needed to help concrete flow through the grid



Accelerator pump

The accelerator dosing pump would be mono or peristaltic type with positive displacement and no pulsation

The accelerator flow is controlled by a flow meter (only monopump)

High viscosity AFA need:

- 2” suction line + hydrostatic pressure
- 1” pressure line

Interactive PLC system with integrated flow rate adjustment

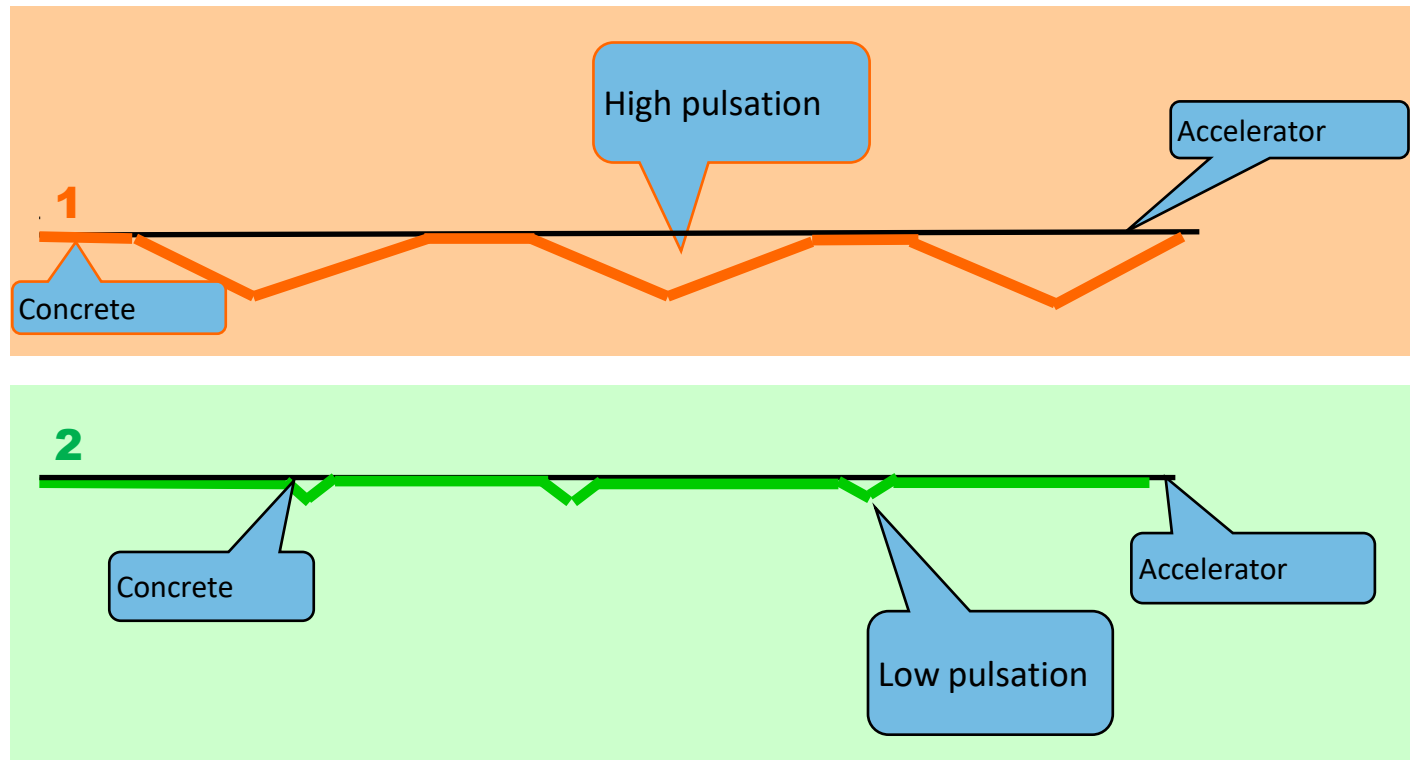


Additional components

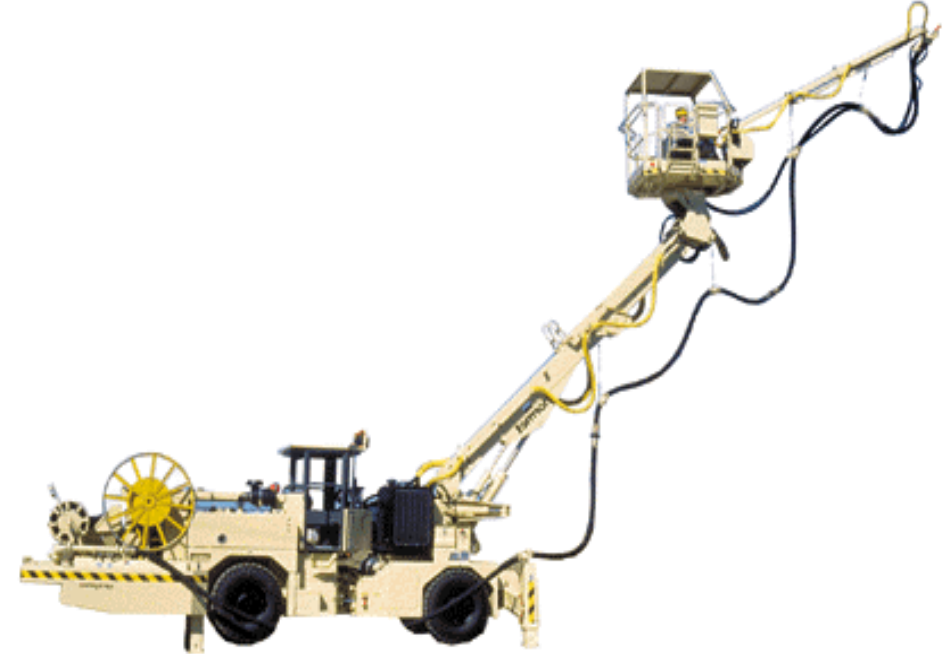
- **Air compressor** with min. capacity of 10-12 m³/min at 6-7 bar
- **Accelerator tank** must be in stainless steel or plastic, typically 1000 litres IBC containers or 500 litres stainless steel tank
- Black iron is not allowed as it reacts with AFA and may create gas inside the tank and/or heavy corrosion
- **Heating jacket** is needed for the accelerator tank in cold conditions
- **Working lights** are needed for worksite illumination and avoid “shadows”



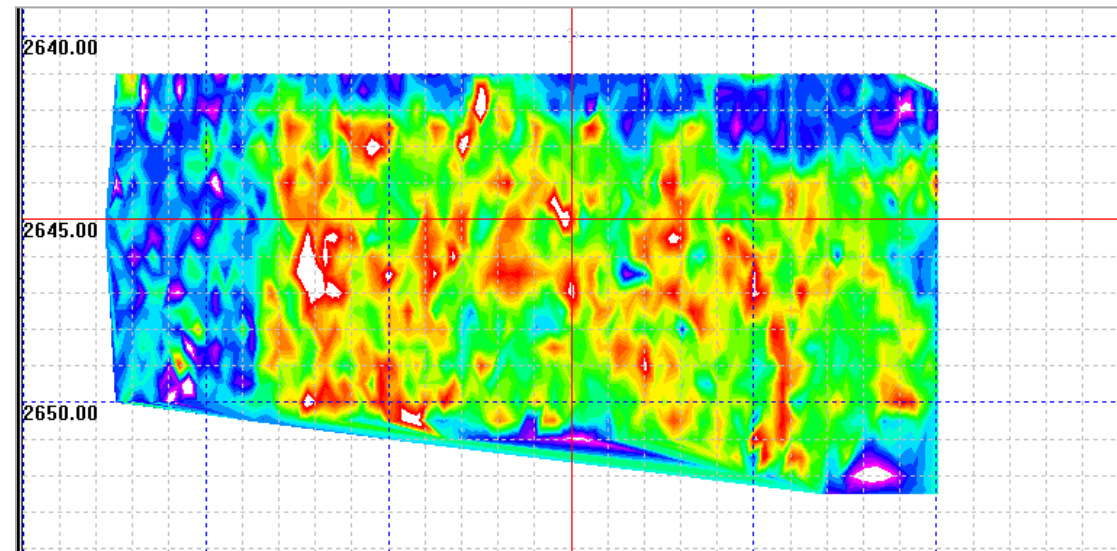
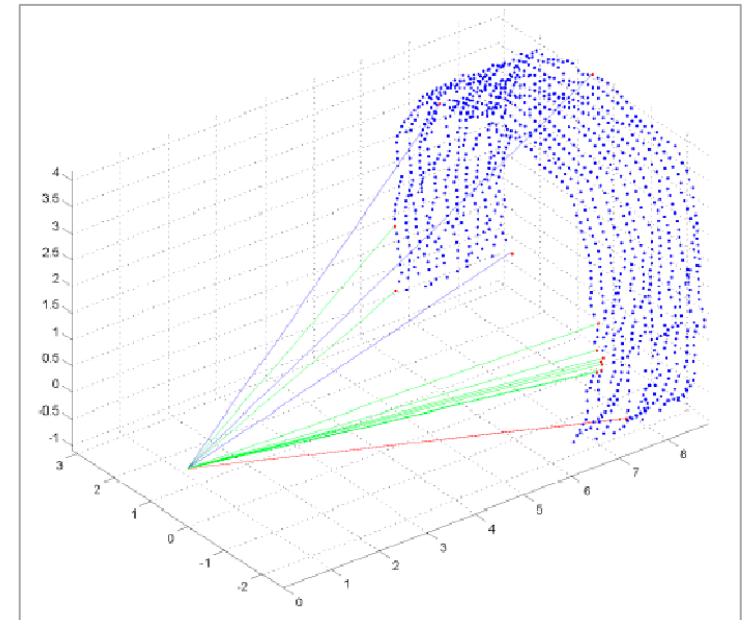
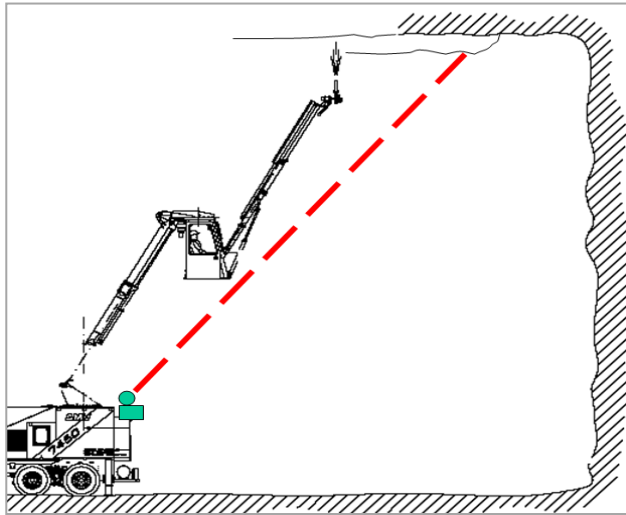
Interaction equipment and shotcrete quality



Different types of robots

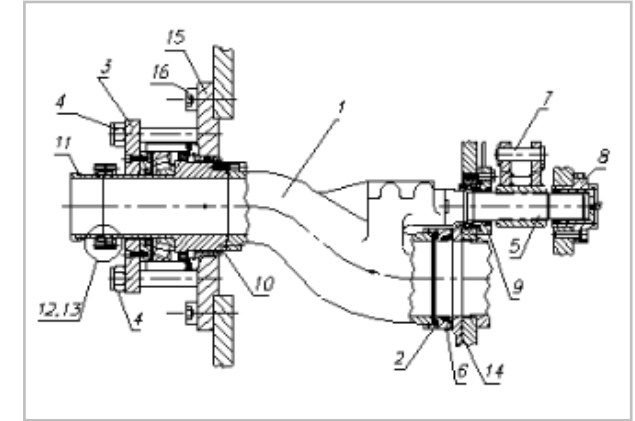


Shotcrete monitoring



The 9 Commandments (1/2)

1. The water box must always be filled with water (anti-freeze if necessary!)
2. The S-Pipe swinging cylinders must be greased daily through nipples or an automatic lubrication device!
3. Check if the oil levels of the equipment correctly filled especially from the hydraulic system and main driving components
4. Check the control functions for the operation of the equipment are in proper working order
5. Always lubricate the delivery pipes and hoses before spraying



The 9 Commandments (2/2)

6. Check that the grid and hopper are clean and that the vibrators works properly
7. Check nozzle and injector holes, air and accelerator lines for any blockages
8. Before spraying or after a container change, check that the accelerator suction hose is completely free of air. If necessary, fill the hose with water before pumping the accelerator through the hose (monopump)
9. Before spraying check that accelerator amount is on the display (% bwc)



Safety responsibilities

- The equipment manufacturer is responsible for product safety, but considerable obligations are transferred to the contractor / owner / user of the machine
- The manufacturer should request information from the owner / user to be sure his safety procedures related to use of the machine are adequate

Note: Please review in detail Responsibilities and Maintenance checklist chapters



Key issues for the Nozzle Operator

- Understanding all the functions of the spraying system and the operating procedures described in the manufacturers instruction manuals delivered with each machine
- Check the machine is technically in order before daily start-up
- Operating the equipment strictly according to the manufacturer's operation manual / owners' instructions
- Report immediately any disorder, the potential for or occurring danger and risks to the machine and operator
- Ensuring the safety equipment and accessories are in good technical order at all time
- The equipment must strictly and only to be used for the designed use
- Be responsible for ensuring the maintenance check lists are followed (daily, weekly, monthly, yearly)

Link to chapter:

[Designer expectations](#)