

# Atlas Copco Geotechnical Engineering Products

## Extensive grouting in Boyabat Dam



*“We are highly satisfied with this Unigrout set-up. Quality is very important to us and we could not find grouting equipment suppliers to match our expectations. I often said that you could use any kind of drilling equipment for drilling shallow holes. It’s just a matter of time. But you can not produce the quality of grout we have achieved if you don’t have the right equipment.”*

Şahabettin Ağaoğlu, Manager-Drilling Section, Ayson

### Ready for hydroelectricity

The Gökirmak valley in Turkey has been an important landmark for the ancient silk route. The Boyabat dam only took four years to be completed - a record for Turkey - becoming an important milestone of regional development by reducing the country’s dependency on importing energy. Atlas Copco has delivered reliability and new solutions in grouting and core drilling to the project.

*Sustainable Productivity*

**Atlas Copco**



With a reservoir of 6,000 ha and an installed capacity of 513 MW, it is expected to generate 1.5 billion kWh of electricity per annum. Now the Boyabat Dam is being filled with water and aim to start generating electricity in early 2013.

#### The Boyabat dam project

The Boyabat area primarily consists of sedimentary rock with high seismicity that is prone to water leakages. This can cause excessive losses putting the stability of the dam foundation and its abutments at risk - particular in such a high seismicity area - as well by loosing precious water through uncontrolled leakage under the foundation. Over 210,000 m of grouting drill holes were needed to seal the leakages and reinforce the dam, approximately 190,000 m used in the three main galleries, 10,800 m in downstream cofferdams and a further 10,000 m in the Dam body.

#### The right choice

When Ayson, a Doğuş Construction company, was awarded the Boyabat Dam drilling and grouting project they chose to use Atlas Copco equipment. Their aim was to install one grout station per bank to feed the various substations located inside the galleries performing curtain, filling and consolidation injection. Recording of the grouting parameters and the water permeability control test was also required. In fact over 33,000 m<sup>3</sup> of grout were injected to give the dam rock solid stability. Atlas Copco proposed Unigrout Smart-A modular grout plants and a fleet of Diamec U6 PHC with NO2 wireline core drilling system on site.



Diamec U6 PHU in action.

#### Mature grout

At Boyabat, Unigrout plants were expected to prepare the cement grouts, mortar and bentonite for the maturing tanks which would be mixed with mortar later. Automatic weight batching Dosac system was critical as the equipment had to prepare up to six different recipes based on the weight of the components. It was the fastest way of ensuring high productivity of the various grouts.

In a typical drilling and grouting plan, the central station produces grout and mortar on each bank which then distributes to the substations located inside the galleries. These substations inject grout into the drilled holes while the injection parameters are electronically monitored and recorded by the portable Logac electronic recording system.

#### A joint venture

But Atlas Copco and Ayson were sure that this system could be made faster and more efficient. So they came up with an innovative modular grouting set-up that eased the transportation of ingredients and kept the production capacity flexible. For each bank, a set of three Unigrout Smart-A22 were put together in one room. Their control panels were moved out into the control room enabling just one man to operate the whole system. Niches were created inside the galleries to accommodate room for the special substations.

#### The result

Each station at Boyabat produced up to 11.3 m<sup>3</sup> of grout and 3.3 m<sup>3</sup> of mortar per hour, and only one of the three Unigrout per station was connected to the sand silo. The teams achieved drilling 48 m/day per machine, with an average of 2 m/hr with a wire line drillstring against 1.3 m/hr with conventional version including time spent on permeability tests. Grouting was performed in an up-stage method with 5 m long sections and holes spacing three meters apart. Downstage grouting could be executed if drilling stopped suddenly. The average bit life reached 1000 m in the medium hard sedimentary formations, but one SC 6-8 matrix bit has reached an astonishing 4 350 m.

#### Customer

Ayson Geotechnical and Marine Co.  
- a division of Doğuş İnşaat ve Tic A.S.

#### Project

Boyabat Dam and Hydro Electric Power Project (HEPP)  
Drilling and grouting

#### Products

Unigrout Smart-A22  
Grouting substation and Logac recorder  
Diamec U6 PHC high-speed core drilling rigs  
SC 6-8 matrix bits

#### Benefits

*Unigrout*  
- Automatic weight batching system  
- Large volume of different grout  
- Recording injection parameters with Logac  
- Versatile  
- Easy to assemble and disassemble (modular)  
- High reliability and easy to clean

#### Diamec U6 PHC

- Powerful, compact design.  
- Unique, versatile, and easy-to-use positioner for drilling in any direction.

#### Conclusion

With a century of grouting knowhow, Atlas Copco can offer fast and efficient equipment for drilling and grouting in dam and tunnelling projects.

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