SIKA AT WORK

CASE STUDY: Sika® ViscoCrete® TECHNOLOGY

CONSTRUCTION OF LNG STORAGE

BUILDING TRUST

SIKA EXPERTISE: CRYOGENIC STORAGE TANKS FOR LNG

PROJECT DESCRIPTION
In 2013 the Northeast of the Yamal Peninsula (South Tambey) became the place for development of a large gas condensate field, which has been started production in 2018. In total three production lines to produce liquefied natural gas (LNG) with a total capacity of 16.5 million tons per year have been installed. Off-loading facilities have been built at the port of Sabetta. This project included the construction of the four cryogenic tanks for liquefied gas storage next to the Yamal LNG plant itself. After the production of the liquefied gas, it will be transferred to and stored in four double-containment cryogenic storage tanks, with a capacity of 160'000 m^3 each.

Operating capacity of the production, storage and dispatch of gas will be about 27 billion cubic meters of gas per year.
Each tank consists of more than 17'500 m^3 of concrete and 3'400 tons of rebar. Approximately 1'000 m^3 of concrete for the base, around 5'300 m^3 as concrete slab, roughly 8'350 m^3 for the tank walls with a height of 44 meters and ca. 2'800 m^3 for the concrete roof.

PROJECT REQUIREMENTS
The customer imposed very stringent requirements on the concrete quality and all its components. The requirements were so serious that the contractor had to refrain from using some local raw materials for the production of concrete and had to import raw materials. For example, despite the high shipping costs, high-quality Portland cement CEM III/A 42,5 N was purchased, sourced from Germany.

For the construction monolithic foundation slab and floor slabs tanks required concrete C35/45 L5 W8 F200, and for construction pre-stressed walls C45/55 P5 W8 F200. Maximum w/c-ratio at 0.40, air-entrainment at 4 - 6% and slump life of concrete mixes of at least 2 hours. In addition, an increase of the slump life of the concrete mix for up to 24 hours was requested.
One of the main objectives was to find the optimal amount of cement to ensure the required performance and costs. The performance of the hardened concrete was critical because the structures are massive and require a large amount of concrete, which can lead to the problem of cracking due to temperature changes and humidity. While the concrete mix should not have excessive viscosity to support the normal workability.

SIKA SOLUTION

Working on the design concrete mixes and their implementation in manufacturing was conducted by specialists of Sika under the operational control of leading scientific research Institute "NIIZHB Gvozdev". At the stage of preliminary selections, it was found that concrete with low consumption of cement and fine sand have the water bleeding. To eliminate this negative factor, it was decided to use 15-25 kg/m^3 of silica fume, allowing to improve segregation resistance of the concrete and increase the strength and durability of concrete. Due to a powerful plasticizer Sika® ViscoCrete®-5-600 SP managed to provide a low w/c-ratio 0.33 and a long slump life. In order to ensure the frost and freeze/thaw resistance of the concrete an air-entraining admixture SikaAer®-200 S was used. Additionally, Sika Retarder®-12 was available and used on request to ensure the retardation and therefore the slump life for up to 24h. In the end, with the use of Sikas mix design and products all the requirements of the contractor were fully met and made this unique project a success.

SIKA MIX DESIGN

Mix design for construction pre-stressed walls C45/55 P5 W8 F200:

Raw Material	Amount (kg/m^3)
Cement CEM III 42.5 N	460
Silica fume	23
Water	152
Sand (0 - 5 mm)	725
Coarse aggregates (5 - 20 mm)	1'120
Sika® ViscoCrete®-5-600 SP	3.57
SikaAer®-200 S	0.39
Sika Retarder®-12	0.92

The requirements were:

- Slump flow: > 65 cm
- Slump life: not less 240 min
- Set retardation time: 8-24 h

CRYOGENIC STORAGE TANKS FOR LNG

PRODUCTS USED
Sika® ViscoCrete®-5-600 SP
SikaAer®-200 S
Sika Retarder®-12

PROJECT PARTICIPANTS
Main Contractor: Rumdel Construction (Cape)/ RBE JV.
Consultant: MBB Consulting Engineers

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