

## Reinforced soil at underground storage facilities

Loukov, district Kromeriz, Czech Republic

CEPRO a.s., a government owned major distributor of crude oil in Czech Republic chose to build a large capacity underground tanks facility in Loukov to improve supply in the eastern part of country. The challenges of reinforced soil structures around tanks were answered by Enka solutions.



Project owner  
**ČEPRO, a.s., Prague**

Products  
**Enka®-Force G 600/50**  
**Enka®-Force G 800/50**  
**Enkagrid® G 60/60**  
**Enka®-Net 40/20**

Functions  
**Reinforcement**  
**Separation**  
**Erosion control**

Contractor  
**Metrostav, a.s., Prague**

Volume  
**345 000 m<sup>2</sup> Enka®-Force G**  
**65 000 m<sup>2</sup> Enkagrid® G**  
**11 000 m<sup>2</sup> Enka®-Net**

### Challenge

Safety is critical for storage of combustible liquids and any failure has to be avoided at all costs. Apart from safety, designers had to cope with other issues such as providing a design for the storage facility with minimal disruption to the surrounding landscape and with minimal maintenance costs. The resulting design aimed for an economical yet stable and long lasting earth structure to completely hide the storage facility. Upon completion of the construction works and installation of technology, the tanks were walled off with a backfilled soil structure causing no earth contact

pressure on the walls of underground tanks with each one holding 35 000 m<sup>3</sup> of crude oil. The whole site was placed in a sloped open pit, secured on the south side by pile walls.

### Solution

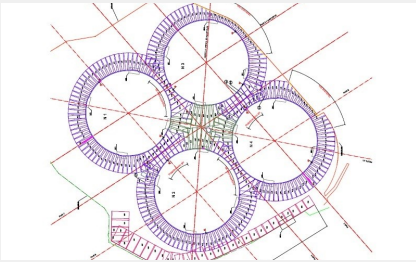
- Geotextile Enka-Force G reinforced vertical soil walls around the tanks, also providing an effective soft facing.
- Geogrid Enkagrid G reinforced slopes for the embankment.
- Enkagrid G and Enka-Net applied as an erosion control solution to the embankment and tank domes.



Construction works and technology in place before the earth works phase



Installation of the geosynthetics between the tanks



Typical layout arrangement of geosynthetic reinforcement around tanks



Detail of the wrap-around facing supported by a steel mesh formwork



Finished outward slope of embankment (inclination 47°) with installed erosion control

The design of 21 m high vertical soil walls around the tanks required installation of the high strength geotextile Enka-Force G. This was placed in an effective wrap-around arrangement with horizontal layers spaced at 0.6 m. This technique reduced the thickness of RC walls to 0.6 m and helped the drainage system to drain off rain water. Excavated soil from the site was reused as a backfill material and compacted every 0,3 m. Steel mesh provided fast and affordable formwork keeping the soft facing at a constant 0,3 m offset from the tanks. All outward slopes of embankment were reinforced with biaxial Enkagrid G with an horizontal spacing of either 0.6 or 1.2 m depending on the slope inclination. Enka-Net was chosen as the erosion control method on the slopes up to 30°. Erosion protection on steeper slopes required a higher strength and the Enkagrid G in green variant was used here.

### Benefits of the solution

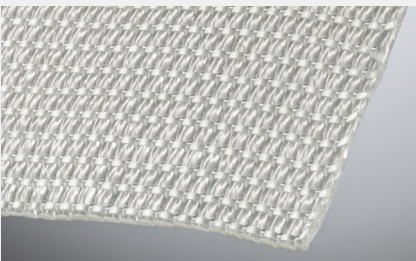
The combination of the products used enabled a complete solution with optimal balance between price and performance. It guaranteed fast and simple installation in all weather conditions and allowed the reuse of excavated soil (300 000 m<sup>3</sup>). Due to the flexibility of woven geosynthetics and wide roll sizes they are ideal for large scale projects of this type.

### Result

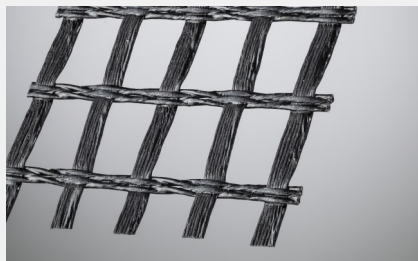
The use of woven geosynthetics in reinforced soil structures has proved to be an economical method of providing modern, safe and long term protection to underground structures.

The design assumes serviceability to be in excess of 100 years.

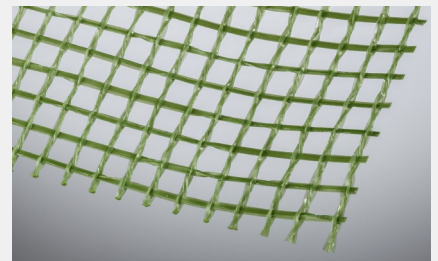
### Products used



**Enka®-Force G**  
High strength 100% polyester woven geotextile for soil reinforcement



**Enkagrid® G**  
100% polyester geogrid with PVC coating for soil reinforcement



**Enka®-Net**  
Woven polypropylene geogrid with PVAc coating for erosion control