

Proviacal[®] application in the construction/stabilization of sediment-based river flood dikes

**Jaroslav Pavlík, Lhoist Czech Republic and Slovakia, Tmaň, Czech Republic
and Lhoist Czech team**

Abstract

The needs to build a new dike as well as to renovate the existing one came up in the Czech Republic after the floods in 2002. The dike construction project has also opened some doors in related areas. One of these is the treatment and reuse of sediments excavated from rivers, ponds and lakes. These types of projects can often times be part of an optimized solution for infrastructure and development planners. As rivers are dredged to clean and deepen in the watercourses and structures, the excavated sediments can then, after treatment with use of **Proviacal[®]**, be applied in the construction of roads and railways embankments or dikes. **Proviacal[®]** is **Lhoist** company registered trademark suited the purpose of soil treatment through liming field.

Soil treatment technology

Soil treatment technology is an application of lime, which is spreading all around the world. Soil treatment through liming has been used widely also in the Czech Republic in recent years for earthwork such as motorway and railway embankments or other commercial projects, including Prague airport. More than two million cubic meters of soil are treated in this way every year in the Czech Republic. Alternative forms of improvement would be very complex and could even involve removing soil from the site.

The lime has a long-term effect on a hydrated aluminosilicates present in the soil. The result is a constant growth not only in the soils bearing capacity but in its stability and anti-slide

coefficient. Another quality improvement is the fact that the treated soils low water content makes it far more resistant to frost.

There is no single recipe for soil treatment. It depends on a number of site specific factors. The first step is to discover whether a particular type of soil can be improved at all. Working at the right recipe involves a whole range of tests, from studying the granular structure of the soil to measuring its bearing capacity both before and after treatment.

When they occur naturally, compact clay based soils that are saturated with water, whether hard or soft in consistency, are quite unsuitable for use in embankments. But if we modify them with an added mixture of quicklime using a dust free process we can alter their properties quite significantly. Their composition becomes more granular, the action of the clay content is minimized, humidity decreases noticeably and the soil becomes usable for normal compaction techniques while at the same time its bearing capacity improves significantly.

This means that unsuitable construction material can now be greatly improved in quality on the site and relatively easily. It is a very simple process when a spreader covers the soil with the layer of lime, which is then worked into the depth of fifty centimetres. The lime reacts with the soil significantly, altering its physical and mechanical properties.

The chemistry is also fairly straightforward. After the lime is mixed into the soil, cations of sodium and potassium are replaced with cations of calcium. The effect of this reaction is to alter the stratified structure of the clay specific minerals, which in turn reduces the soils capacity to bind with water and changes its granularity. It is worth noting incidentally that the by-product of this reaction is a considerable release of heat caused by lime slaking.

The investors can see at least two benefits of this technology. The first is that they can shorten the time spent on preparing and carrying out the project such as flood embankments, instead of waiting for the right weather and having to delay completion by one or even two years as another advantage of this method is that it can be carried out in wet weather when earth moving work generally has to be halted. The second, equally important benefit is the possibility to use the material available on the site and reducing the amount of transport involved.

Dikes built from Proviacal®

Floods which came into the Czech Republic in 2002 brought not only great loss of life and extensive damage of property but also drew attention to the need to be better prepared for such natural disasters.

Lhoist company, producer of **Proviacal®** (special lime for soil treatment technology), was the first to introduce the soil treatment technology not only for building of roads, railways and private investor sites, but also for building and reconstruction of dikes and flood dikes in the Czech Republic. One of the main things is that we now have a technology that enables us to use materials for construction that in the past were regarded as waste, e.g. silt excavated from the river. After excavation we are left with a mixed material, which in its untreated state is not suitable for construction. With this technology, however, we are able to upgrade it to a state when it can be used not only in road and railway embankments but also for dikes and other water containment structures.

One of the places where this technology has successfully been used is the dike of Chobot pond near Milevsko, which was destroyed by floods in 2002 (see Figure 1). It had to be rebuilt quickly but the engineers ran into a problem. The saturated soil proved very unstable and therefore unsuitable as a construction material. So they considered two options. The first, used till that time, was to bring new soil to the site. The second was to treat the existing soil so as to make it suitable for construction. They chose the second option to improve the quality of the soil by adding lime, which was the solution offered by **Lhoist** company (see Figure 2).



Figure 1: Destroyed dike of Chobot pond near Milevsko during floods in 2002.



Figure 2: Dike of Chobot pond near Milevsko after reconstruction when soil treatment technology with **Proviacal**[®] was used.

The construction of flood dike along the Labe river in Pardubice also used the soil treatment technology. The building of this flood dike was divided into two time periods. The construction works of the first period were finished in 2004. This flood dike has been built from soil treated with **Proviacal**[®] RD (low dust special lime for soil treatment technology).

Recent floods in 2006 proved the right use of soil treatment technology in such important flood constructions. The construction works of the second period are carried out and the flood dikes are built mainly from sediment excavated from the Labe river (see Figure 3). This sediment also has to be treated with **Proviacal**[®] to become a suitable material for building of the dike.



Figure 3: Excavated sediment from Labe river near Pardubice is treated with **Proviacal**[®] and used for flood dikes construction.

The reconstruction of Hvězda pond dike near Svitavy is another case where soil treatment with **Proviacal**[®] was used. This dike was also damaged during floods in 2002. The reconstruction works of dike were begun without soil treatment. However, during these works the instability of the dike body was observed. Compaction of very wet soil and usage of unsuitable compacting machines were the main of many other causes of this instability (see Figure 4). To solve this big problem, **Lhoist** company offered the soil treatment technology to the investor of this building (see Figure 5 and 6). In this way, the construction works could successfully continue with full use of local material and without long-term interruption.



Figure 4: State of Hvězda pond dike before usage of soil treatment technology with **Proviacal®**.



Figure 5: Soil treatment technology with **Proviacal®** used during reconstruction of Hvězda pond dike.



Figure 6: State of Hvězda pond dike after usage of soil treatment technology with **Proviacal**[®].

The flood dike construction in Hradec Králové is also carried out with soil treatment technology. The soil and sediment excavated from the river have been treated with **Proviacal**[®] and used for this flood dike construction (see Figure 7).



Figure 7: Soil treatment technology with **Proviacal**[®] used during building of flood dike in Hradec Králové.

Conclusion

For decades, large scale civil engineering projects have been associated with massive excavation and the shifting of vast quantities of earth. Now, thanks to the simple technology of adding lime to the soil, this may be a thing of the past.

The floods, which have affected the Czech Republic recently demonstrate the significance of the right flood control. It is evident that flood dikes play a very important role in protection of areas endangered by floods. It is therefore great that soil treatment technology is used more and more and helps in this big problem, which the floods definitely are.