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Stabilization techniques in railway track maintenance

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Abstract

Stabilizing or recycling soils has been a solution when you have problems with the quality or the behaviour of the built platform. It is an easy way to repair, quick and efficient, and there is in the market enough number of companies that can do this work with a big experience repairing soil platforms.

Keywords: punctuality, stabilizing, recycling, efficiency, quick repair

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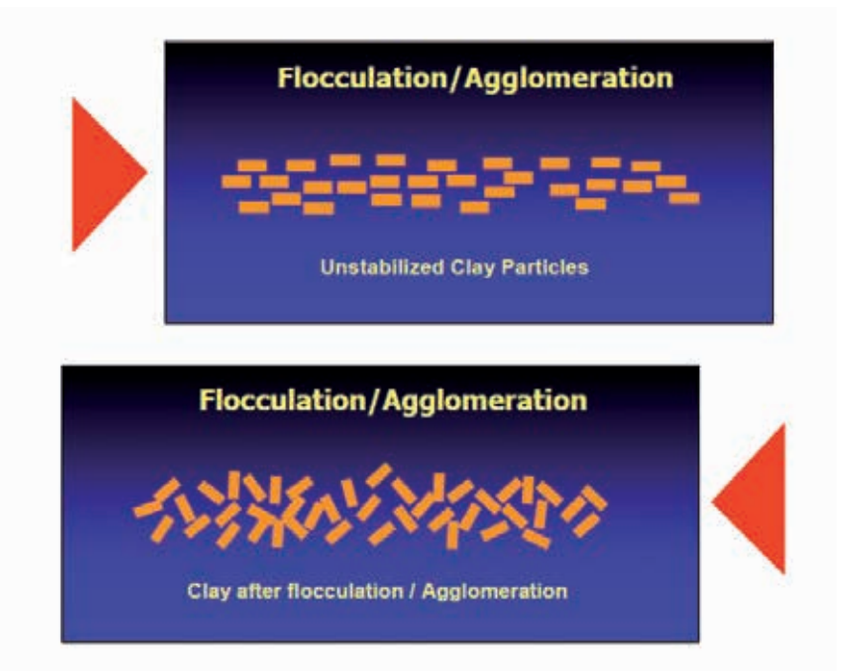
1. Introduction

Much of the success of the high speed train is due to its reliability, along with a large number of frequencies in the lines that are already exploited. Renfe announcement since the beginning of its operation in Spain on the refund of the ticket if the delay is more than a quarter of an hour breaks radically with the idea that associated with the carriage of passengers by rail with delays and uncertainty of the time of arrival and at this time the AVE (Alta Velocidad Española, Spanish High Speed) is associated with punctuality and safety arrived at the scheduled time, well above the air transport.

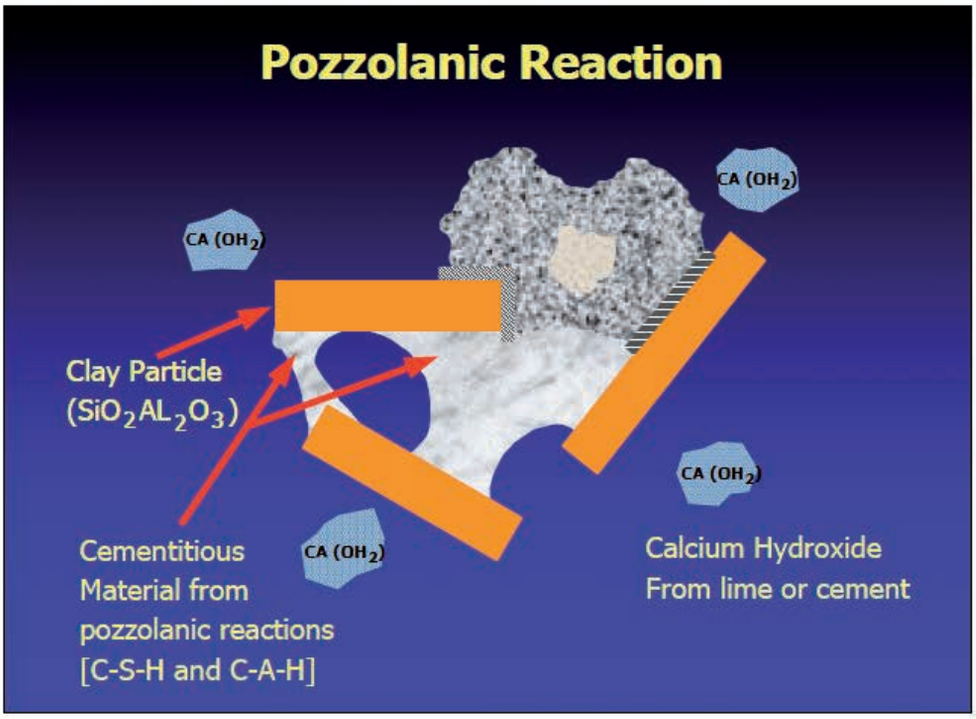
This is possible thanks to a minimal disruption in maintenance, so it highlights the enormous importance of having an infrastructure in which the maintenance, although essential, is never reason to cause delays in the operation of the track.

Using more reliable building materials than the merely natural, together with maintenance carried out with these same materials facilitates this work.



We currently have new forms of reparation of the platform of the sections on service in cases which detects the presence of materials not suitable to the function for which were intended, transforming them through the process of stabilization, which gives an immediate improvement, improving even more their characteristics as time goes on, without having to take them out and replace them with others in the short time that we use to have for repairs.

In Spain we have a group of companies with a park of machinery with capacity to stabilize layers of 0.5 m depth at one time without having to remove them, which allows a great capacity for repair of damaged layers. These powerful machines are normally accompanied by vibratory rollers compactor can densify these thicknesses of layer with guarantees, capturing dynamic plate module reached through compactometers at the same time and keeping these records in easily readable files which can be used to observe the evolution of the affected area with the passage of time.



You can reach rigidities of the platform depending on the amount and the type of cement used so that you get an immediate commissioning. Even if it were essential to achieve tremendous rigidity in the first hours of operation, also setting accelerators may be used.

In the works in which by the nature of the soil, you must use lime as conglomerate, commissioning can be immediate since lime acts quickly transforming the soil, while the strength gain can be increased with the passage of time producing a cementing of this soil, slow but inexorably.

The same occurs in relation to the maintenance of service paths, although these are not critical for the correct operation of the track or have restrictions as demanding like this available for repair periods. If the goal is to build so that maintenance is cheap and durable, it is clear that this is a field in which we have to take in account without any doubt with stabilized materials, without having to reach the employment of more expensive materials such as concrete or asphalt mixtures.

2. The technique of in-situ recycling - stabilizing

The technique is very simple and it is running since antiquity, although currently with media that make the cost-effectiveness and speed, very low.

It mainly consists of mixing the existing soils, whatever the quality they are, with the right binder in each case and the amount that is prescribed to achieve a certain result, with very few restrictions that will be described later.

This way or repairing demands some previous work more than traditional solutions replacing material by a harder one, but the results are well worth. Rigidities reached can be 10 times higher than the existing soil, or bigger depending on the circumstances, and therefore durability may also be much greater.

The binders used are usually Lime and Portland Cement, that are sufficiently known in the

world of the construction of the public works with regard to its functioning, characteristic works, improvements that provide, cost, availability in the environment of the works, tests that should be carried out to control quality, etc, what is without a doubt a great advantage over other possible new materials based on polymers from petroleum or other sources.

Photo 1 Drying the platform

Each binder works in a certain way, has different advantages and their employment is not normally function of its price at each site, but the quality of soil which have to stabilize.

Briefly, when we operate with lime we produce a chemical reaction with clays, so that it breaks the laminated structure, which provides a great absorption of water, "soapy" appearance to glide particles on other, turning it in something more Sandy in appearance, which it decreases absorption of water, structure pass from SOAP to granular and increase significantly the capacity to support, obtaining CBR values from to 2 or 3, to values 20 or 30 with small additions of lime, usually around 2% lime, usually in the form of quicklime.

Lime cannot react with granular materials and not plastic materials so that its effect is clearly diminished and therefore is not recommended in these materials.

However cement works sticking mineral particles as stable and long-lasting glue, inferring materials treated with a greater resistance to getting excellent rigidity in time relatively short but also controllable through the type of cement, the endowment or additives that could be added.

In any way at any time one could speak of rigid or flexible solutions, but simply solutions to the type of soil that can be used on platforms already built and different ways of adapting them to the function to be fulfilled according to the dimension or the site where this soils have been placed.

The only restrictions you have to use this technique are to avoid any chemical reaction in the soil with the binders added that may produce some material that evolves with the passage of time in a bad way. It is known that this effect may occur when there is enough ion sulfate (SO3)

that can react with free lime (Ca) added with the lime or the cement.

It forms a molecule (Ettringite) which stable form has 24 molecules of water and it has a very big swelling pressure during its formation.

Another bad circumstance may be the presence of stones bigger than the size recommended by the administration, 80 mm. bigger stones can cause great damage in the machine with a big cost.

3. Repairing areas with problems with soft soils or inadequate materials

It is not necessary to look for works in which similar loads be supported, or even higher, such as aircraft landing platforms or containers platforms in a port to be able to extrapolate the benefit of this technique to other fields.

In the following works, we will briefly describe the existing problem and the solution adopted the form of execution carried out.

Photo 2 Drying the platform in Olmedo

As an example, we have selected the following works:

- Repair by stabilization with cement on the platform already constructed the LAV Zaragoza to Lérida as solution to the emergence of subsidence on the platform at the time of the installation of the track.
- Drying the platform in the high speed line Madrid – Valladolid, in Olmedo, to accelerate the delivery of the work

Description of each one of these works:

- Repair by stabilization with cement on the platform already constructed the LAV of Zaragoza to Lérida

The problem in this section of the Madrid - Barcelona line was the emergence of soft soils,

which originated many collapses in the platform, built two years earlier, at the time of the Subballast layer prior to placement of the track.

Photo 3 Stabilizing the platform in Zaragoza

The solution adopted was stabilization with cement, dry way, through the upper 30 cm for this platform providing the rigidity that lacked the floor of the platform only in the sections where the soil failed.

Before, they made some tests assuring that there were no SO3 problems in the soil.

The reparation was made very quickly without disturbing the rest of the works.

- Drying the final platform in the high speed line Madrid - Valladolid, in Olmedo

The 2002 winter rains soaked the entire platform of the work in this, which put into question the delivery from the stretch of corresponding work. That was the reason why it was decided to dry this platform by applying a small amount of quicklime in the most humid areas in the upper 50 cm platform getting the goal within a few days.

The only control they had to do was to check the final humidity and the compaction of the layer before setting the last one.

4. Conclusions

Soil stabilization is a solution to be considered in areas where for any reason the soil has failed or prevents to proceed with the work under the contracted deadlines.

The reason to choose the binder in each case is not its cost but the greater or less affinity with the type of soil that we have in our jobsite. The action of each binder is different in hardness and the speed is achieved. In soils with plasticity index greater than 15 we should better us quick lime as Binder but soils with Ip rates below 20 is usually recommended to use cement. (For materials with Ip between 15 and 20, would have to see other parameters).

The machinery necessary to carry out these stabilizations is usual machinery existing in the market, making it easy to work with that technique. The thickness that can be reaching by this machinery becomes 50 centimeters for mixing, which can be compacted with heavy rollers, more than 16-18 tons, usual in this type of work.

It is advisable to make prior to the execution analysis to predict the evolution of the area repaired in terms of hardness achieved platform and to see the amount of binder to be applied.

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