Wrinkles, Bridging, and Ballasting Geomembrane During Installation

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ABSTRACT: This article seeks to establish a series of reflections on what may be the best treatment of the effects linked to changes in temperature and wind during the installation of a geomembrane.

It is conceivable that a manufacturer of geomembranes has little to teach to an installation company on many aspects related to the installation. Of course, it is the case.

However a manufacturer can have a very deep understanding of the behavior of manufactured materials which together with the permanent contact maintained with hundreds of installation companies and in very different environments, with Project Designers and Project Managers from very different backgrounds and experience, allow us to store a lot of information that is which gladly want to share.

1 INTRODUCTION

A polymeric geomembrane provides a behavior to temperature changes, basically linked to their crystallinity.

Perhaps the most used of all, the high density polyethylene HDPE, is precisely the one with the highest percentage of crystallinity (> 50%) and this fact is responsible for all the problems that arise during installation caused by temperature changes and the expansions and contractions that appear as a result of them. Crystallinity provides to HDPE relevant chemical resistance and UV durability, which in turn are justifying its widespread use in waste safe containment applications and large water storage.

In contrast, it offers a high coefficient of linear expansion, what it forces the installer, among other concerns, to have temperature parameters under control.

As an introduction we will reflect on two ideas.

• Changes in temperature generate expansion and contraction. Consider a piece of material 100 lm length experiencing a temperature increase from 20°C, that is the ambient temperature within the factory, to 40°C for example.

Expansion **Δ=100 . 2,15.10^{-4}.(40-20)= 0,43 m = 43 cm**

• Exposure of the geomembrane to UV radiation increases more or less the temperature depending on the color, black being the maximum absorption, over thermal gap on the ambient temperature. This affection sometimes justifies that temperature of the geomembrane surface is 70°C or even higher. With the example of the previous case, there would be an extra UV expansion which should be added to the previous one.

Extra UV expansion: **Δ=100 . 2,15.10^{-4}.(70-40)= 0,645 m = 64,5 cm**

The sum of both gives an idea of the problem of expansions and contractions which logically has to face the Installer. They cause wrinkles, raisings and terrain bridging from support, effects that are the subject of this document.

2 DESCRIPTION, DEVELOPMENT AND CONSEQUENCES OF THE WRINKLE AND SEPARATIONS

It is logical to think that a wrinkle by expansion or a separation from ground support, will recover as soon as the temperature drops to the initial state. But this is not entirely true for two reasons:

• Because the geomembrane has its own weight and angle of friction at the interface support with its bearing and therefore, is capable of storing captive tensions. By this fact we know that it will not be the same a geomembrane lying directly on the ground to one that rests through geotextile.

• Nor is it the same, a slope geomembrane where the wrinkle of expansion by own weight shifts to the bottom and then must recover against gravity, to another geomembrane located in flat bottom where wrinkle recovery is immediate.

Based on the above two effects, the installer should be aware of the degree of expansion within the geomembrane panels throughout the day and thus try not to accumulate too many captive tensions at the end of the day, which will prevent to the geomembrane entirely recover wrinkles and risings.

If both remain, we must conclude that temperature control has not been adequate and we will have to study the influence of these in the implementation of the geomembrane to take the necessary corrective measures.

To finish raise the problem is to remember one last very useful concept to my judgment.

Anywhere in particular, room temperature evolves throughout the year. The end customer is who usually choose the time of installation of the liner, so that in fact this decision is conditioning the temperature range in which it will play out the Installer. Consequently we could have a temperature of "closing" of the Installation of the geomembrane which may be different from the average temperature of the place.

Thus, if we conclude the work in full winter season it is evident we could expect large wrinkles in summer and, conversely, if we close a work in summer, separations could be expected in winter.

Clearly the above hypothesis is set to geomembrane exposed. Otherwise if it is covered by the liquid or solid to store this temperature is determinative of the actual situation.

With these premises, the installer can choose to work at night in summer to lower the temperature of closing or search the hottest hours of the day in midwinter to raise it, but nevertheless can not work miracles.

3 POSSIBILITIES OF TREATMENT

There are different possibilities to face wrinkles and risings that considered not acceptable need treatment.

A wrinkle under the pressure of the liquid or solid to be stored is definitely an air bubble under the geomembrane and will not be detrimental to it when it could disappear in the process of loading and ground deformation support underneath. The factors are therefore:

• supporting soil deformability

• Soil support porosity, either naturally or by the inclusion of a drainage geocomposite. Even a drainage network at the bottom is a way for air to escape.

As a rule, the criteria for a wrinkle is not to be higher than 60% of its width, starting from where obviously it separates from its support. The idea of this approach is that the wrinkle never has available excess material so that when the liner is put into service can not form a loop of material that could be pinched and so that plasticized for the weight of the content.

There are methods to decrease the size of the wrinkle by using special geomembranes:

• With coextruded light-colored geomembranes, usually white or ochre, we are reducing by up to 70% the section of expansion by UV radiation, but nothing of the first section of thermal gap, and therefore the range of 40-50% the average size of wrinkle.

• Sometimes the use of textured geomembranes by the bearing face, significantly increases the friction angle on this interface reducing wrinkles by introducing captive tensions which is not always good measure.

The raisings have different treatment. Initially a bridging from ground support will involve more stress in the geomembrane when this is put into service.

However, just a slight calculation to show that the bridging should be very large for significant deformations in the geomembrane and also that these would be very far from the elongation at yield of it.

But it is clear that a separation is a captive stress and also is not very costly to repair.

4 WIND. PROVISIONAL AND PERMANENT BALLASTING

The wind is by far the biggest enemy Installer.

Geosynthetics are usually lightweight products and wind generate suctions passing through inclined planes or elevations when it has the opportunity to enter under a geosynthetic.

So, we talk about ballast against wind and within them, the provisional with bags during installation or the permanent one, with many other alternatives for the commissioning of the work. (See photos)

In my view it is very important to differentiate between ballast and anchorage, they are not the same.

A geomembrane anchor is the end finishing on the edge of it. A ballast is an extra weight that is placed along its route to avoid raisings. For this last reason a ballast must never entail the loss of continuity of a geomembrane.

A ballast is also a measure against wind and it will never serve to combat a wrinkle or a bridging.