



COLETANCHE[®]

by  **AXTER**

INSTALLATION SPECIFICATIONS

COLETANCHE geomembranes
(ES, XP, AXTER TP)

OCTOBER 2019

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► 1. PURPOSE

This document defines the fields of application and installation techniques for the COLETANCHE bituminous geomembrane for the waterproofing of civil engineering structures.

The following are applicable in this installation specifications document:

- the general recommendations for geomembrane waterproofing, part 10 of July 2017 of the French Committee of Geosynthetics (CFG).
- the general recommendations for the use of geosynthetics at waste disposal centres, part 11 of 1995 of the CFG.
- the SETRA technical guide of November 2000: "geomembrane waterproofing of structures for road run-off water", AFNOR standard P84500 series.

► 2. APPLICATIONS

The geomembranes of the COLETANCHE ES, XP and AXTER TP ranges are intended for waterproofing civil engineering structures for:

Environmental protection, containment of solid or liquid products

- Domestic, industrial and mining waste.
- Areas for composting, bottom ash stabilisation, ore extraction.
- Methanisation platforms.
- Biogas barriers.
- Dams and basins for decantation of polluted water.

Hydraulics

- Dams, waterways, irrigation canals, reservoirs and basins, hillside dams, bank protection.

Rail or road transport

- Channels, basins, medians, waterproofing under railways, ditches.
- Protection of water tables, response to European water law.

Note: this list is not exhaustive and is provided for information purposes only.

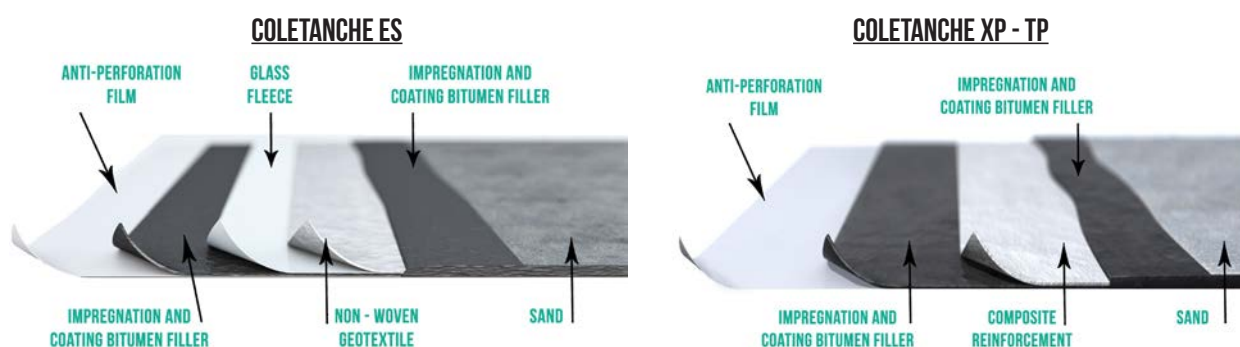
► 3. DESCRIPTION

COLETANCHE geomembranes are made of elastomeric bitumen and:

- a dual reinforcement that combines a long-fibre non-woven polyester geotextile with a glass mat for the COLETANCHE ES range (ES1, ES2, ES3, ES4),
- a single reinforcement consisting of a stabilised polyester geotextile for the COLETANCHE XP range (XPC, XP1, XP2, XP3, XP4) and COLETANCHE AXTER TP.

COLETANCHE has a sanded upper surface and a smooth underside coated with a terphane film.

All the COLETANCHE products in the XP range are certified by ASQUAL.



3.1 Physical characteristics

At lower thickness, a single reinforcement product (XP range) can have a binder amount equal to or greater than a dual reinforcement product (ES range).

PHYSICAL CHARACTERISTICS: RESULTS OF INTERNAL CONTROLS, AVERAGE VALUES												
	STANDARD	UNIT	ES1	ES2	ES3	ES4	XPC	XP1	XP2	XP3	XP4	AXTER TP4
THICKNESS	ASTM D5199	mm	3,5	4,0	4,8	5,6	2,2	3,2	3,2	3,7	4,2	4,0
SURFACE MASS	ASTM D3776	kg/m ²	4,20	4,85	5,80	6,40	2,50	4,30	4,30	4,90	5,50	5,30
WIDTH	EN 1848-1	m	5,10				5,10					2
LENGTH	EN 1848-1	m	100	80	65	55	140	100	100	80	65	15
AREA		m ²	510	408	331,5	280,5	714	510	510	408	331,5	30
REINFORCEMENT		g/m ²	200	250	300	400	175	175	200	250	300	250
TYPE			Polyester				Stabilised Polyester					
BINDER			Elastomeric bitumen									

3.2 Mechanical performances

The types and different weights of the COLETANCHE geotextiles affect the thickness and mechanical performance of the geomembrane. A thinner geomembrane may have a mechanical performance equal to or greater than that of a geomembrane of greater thickness.

MECHANICAL CHARACTERISTICS: RESULTS OF INTERNAL CONTROLS, AVERAGE VALUES													
	STANDARD	UNIT	ES1	ES2	ES3	ES4	XPC	XP1	XP2	XP3	XP4	AXTER TP4	
TENSILE PROPERTIES	Longitudinal	ASTM D7276	kN/m	22	27	33	35	19	19	20	26	28	-
MAXIMUM TENSILE STRENGTH	Cross direction			18	24	29	30	16	16	18	22	26	-
TENSILE PROPERTIES	Longitudinal	ASTM D7276	%	50				40				-	
MAXIMUM ELONGATION	Cross direction			50				40				-	
TEAR RESISTANCE	Longitudinal	ASTM D4073	N	750	825	950	1225	600	600	650	800	900	-
	Cross direction			500	700	850	1025	500	500	600	750	850	-
FLEXIBILITY AT LOW TEMPERATURE	Longitudinal	ASTM D5147	°C	-20				-20				-	
	Cross direction			-20				-20				-	
STATIC PUNCTURE		ASTM D4833	N	450	530	570	650	400	430	490	580	650	-
PUNCTURE RESISTANCE BY AGGREGATES		NF P 84-510	kN	20	25	25	25	-				-	

3.3 Water and gas permeability

WATER AND GAS (METHANE) PERMEABILITY: RESULTS OF EXTERNAL CONTROLS*												
	STANDARD	UNIT	ES1	ES2	ES3	ES4	XPC	XP1	XP2	XP3	XP4	AXTER TP4
WATER PERMEABILITY	ASTM E96	m/s	≤ 6.10 ⁻¹⁴				≤ 6.10 ⁻¹⁴					≤ 6.10 ⁻¹⁴
GAS PERMEABILITY	ASTM D 1434-82	m ³ /(m ² .j.atm)	≤ 2.10 ⁻⁴				≤ 2.10 ⁻⁴					≤ 2.10 ⁻⁴

* Values reported based on the performance of the minimum thickness.

Note: in general, increasing the thickness of the geomembrane reduces gas permeability.

3.4 Coefficients of friction

The table below presents the results of a sliding angle measurement study ϕ' of different materials (natural or geosynthetic) placed in contact with the smooth or sanded side of a COLETANCHE bituminous geomembrane.

TESTED SIDE OF THE BITUMINOUS MEMBRANE	MATERIAL IN CONTACT WITH THE BITUMINOUS PLATE	ANGLE ϕ' (°)
SMOOTH	Crushed gravel 0/31.5	33
	Sand 0/5	25
	Geotextile 011/400	21
	HMA plate	36
SANDED	Crushed gravel 0/31.5	38
	Geotextile 011/400	32
	ENKADRAIN E8004H/5-1s/D110P.	36
	ENKAMAT 7010W/5/H20.20.PET	30
	ENKAMAT 7010W/5/N.80.80.PP	27
	Topsoil 1 (sandy)	36
	Topsoil 2 (clay)	36
	In situ cast concrete: test after 15 min.	36
In situ cast concrete: test after 8 min.	>45	

Lyon INSA study, 2002, according to the NFP 84-522 standard.

Note: with special manufacturing, it is possible to obtain the same coefficient of friction of the sanded side on both sides of the geomembrane. This “High Friction Angle” option is available for all ranges, please contact us.

3.5 Resistance to microorganisms

Microorganisms have a very limited effect on bitumen.

US Atomic Energy Agency Study, Hanford, USA de 1986 (R.E. Barletta, B.S. Bowerman, and C.E. Shea, “Biodegradation Testing of Bitumen”, in Scientific Basis for Nuclear Waste Management X, MRS Symposia Proceedings, Vol. 84, pp.399-405, 1986).

3.6 Animals

Small animals such as rats do not cause any damage to bitumen-impregnated materials: Test report 2012/78 of 1979 of the Central Laboratory of the prefecture of police of Paris.

3.7 Resistance to roots

COLETANCHE ES, XP and Axter TP4 are resistant to roots: Internal test report no. 13055 of August 2012. Tests performed according to EN 14416 (resistance to lupine seed).

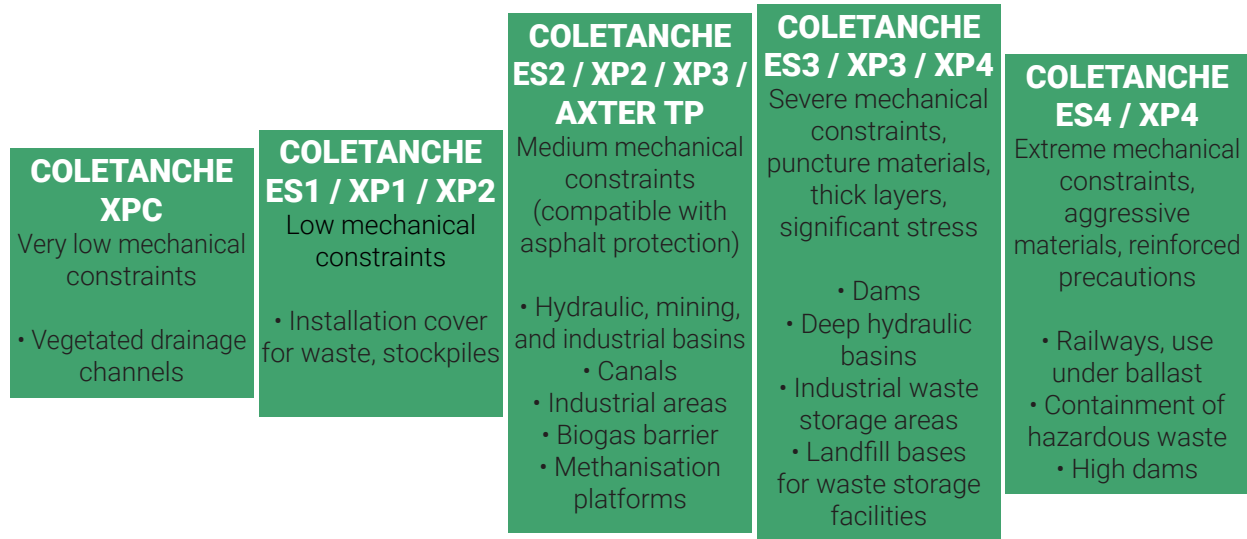
3.8 Geomembrane contact with drinking water

Products of the COLETANCHE ES range are approved by the US NSF61 for the storage of drinking water in reservoirs greater than 150,000 gallons. In France, bituminous geomembranes are authorised for the storage of raw water (before treatment) intended for human consumption.

► 4. CHOOSING A GEOMEMBRANE

Given the diversity of subgrades, nature of protection and operating conditions, there are no definite rules for selecting the type of COLETANCHE.

The performances of each Coletanche grade nonetheless help specify:



► 5. SUBGRADE REQUIREMENTS

5.1 Definition

A geomembrane waterproofing solution comprises:

- the ground formation,
- the subgrade layer (which can contain a drainage system),
- the waterproofing layer (geomembrane),
- the protection layer.

Note: in simplified cases, the ground formation level can directly constitute the subgrade layer.

5.2 Surface conditions

The subgrade layer must be:

- free of rough element likely to damage the geomembrane (sharp objects, projecting flints or any other puncturing element),
- free of vegetation and organic plant matter,
- free of ruts to avoid excessive tension in the geomembrane.

On the metric or decametric scale, level defects up to 5 cm under a 3-metre straight edge are accepted. The centimetre size defects are not accepted. In order to meet this condition, it is generally recommended to perform careful compaction of the subgrade.

It is sometimes necessary to place a geotextile between the subgrade and the geomembrane according to the grain size and angularity of the materials constituting the subgrade. It may be economically preferable to choose a higher-grade geomembrane without placing of a geotextile.

5.2.1 Slope level

A slope level of 3% to 4% must be provided for the cleaning-up of the site and the emptying of the basin.

5.2.2 Slopes

The slope must always be less than 1/1 for inclines of 8 metres and more, to ensure proper holding of the geomembrane under the stress of its own weight for a long duration (creep, sliding) and to eliminate the risks of slope sliding.

Note: these indications do not take into account the constraints imposed by a drainage layer or a possible additional layer.

5.2.3 Transition at the slope base

Smooth transitions between slope and the waterproofing solution should be provided in the form of a rounded finish of radius greater than 20 cm. This can be achieved by sand or compacted site materials.

5.3 Drainage

Drainage under the geomembrane is necessary if there is a risk of water or gas being present (especially in the case of large variations in the water table).

Water drainage: it is positioned under the geomembrane to drain the water from the natural ground (presence of groundwater or source). It can also be positioned on the geomembrane in the case of waste storage bins to capture leachates, limit the hydraulic load on the geomembrane and avoid destabilisation of the subgrade structure.



Photo : Gas drainage at the bottom of the basin (Wavin, 2014)

Gas drainage: it is positioned under the geomembrane to discharge the gases generated by the development in organic soils.

Note: Gas drainage does not work if it is filled with water.

5.4 Bearing capacity

Geomembranes guarantee only the waterproofing of the structures but do not provide any structural elements. The subgrade must have sufficient bearing capacity:

- CBR index greater than or equal to 10,
- PF2 bearing (greater than 50 MPa)

5.5 Acceptance of the subgrade structure

The applicator may reject the subgrade structure if it does not have the qualities required to suit the waterproofing structure.

► 6. WATERPROOFING REQUIREMENTS

6.1 Packaging

6.1.1 COLETANCHE Axter TP

Rolls of standard width of 2 m and length of 15 m, packaged around cardboard mandrels and with a total weight of 150 kg. The sanded side is positioned inside the roll.

6.1.2 COLETANCHE ES et XP

Rolls of standard width of 5,10 m and standard lengths defined for each grade so that the weight of each roll does not exceed 2,5 tonnes.



Note: it is possible to adapt the widths and lengths of the COLETANCHE ES and XP geomembranes depending on the specificity of the structures, please contact us.

These rolls are packaged around steel mandrels whose characteristics are as follows:

- weight: 110 kg
- length: 5.47 m
- outer diameter: 168.3 mm
- inner diameter: 158.3 mm

The sanded side is positioned outside the roll. A continuous green border located approximately 20 cm from the end indicates the overlap width to be respected between two rolls.

The anti-perforation film side is inside the roll. A silicone protective film is placed on the width of the weld strip, i.e. 20 cm.

Two-piece rolls

Some rolls may have a cut section. A yellow tape on the package indicates this type of rolls and the lengths of both are specified.

Label

The film side has a continuous strip indicating the type of COLETANCHE. The label on the packaging specifies:

- the grade of Coletanche,
- the manufacturing number and date,
- the CE marking,
- the reference certification (Asqual or other).



6.2 Unloading and storing of rolls

When unloading (COLETANCHE ES and XP only), precautions must be taken to avoid damaging the rolls. A suitable lifting gear must be used with a lifting or standard beam to ensure proper and safe unloading.

The rolls must be stored elevated, not superimposed, on an area provided for this purpose. It is recommended to rest the mandrels on blocks or beams.



6.3 Installation

6.3.1 Installation conditions

- Possibility of welding the geomembrane between -35°C and +40°C in certain extreme geographical areas, after study or agreement of the Project Management.
- Dry weather.
- The impact of the wind depends on the thickness of the geomembrane. The wind speed may not exceed 35 km/h.

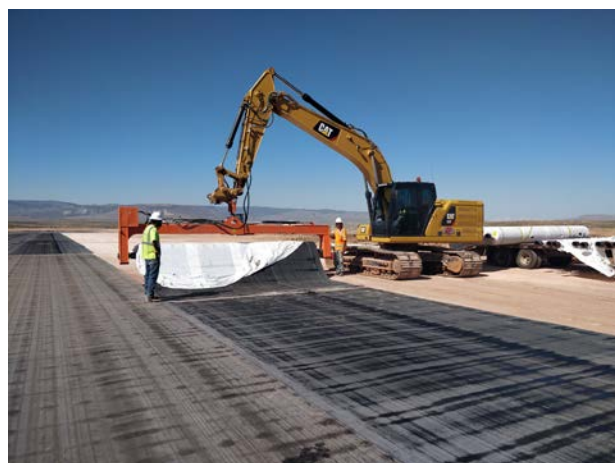
The weld areas must be clean and dry.

Additional useful products:

- ANTAC GC cold primer: primer for joining concrete, steel and other specific points
- MAT 100 screen: 100 g/m² glass mat for flame protection of geotextiles or other sensitive materials.
- Bitumseal: bituminous binder used as waterproofing reinforcement or bonding.
- Hyrène Spot ADH: self-adhesive membrane used for bonding.

6.3.2 Unrolling and positioning of the geomembrane

The COLETANCHE ES and XP rolls are handled using a hydraulic excavator of 20 to 25 tonnes, if possible on tracks. The unwinding is done using a hydraulic (connected to the hydraulics of the excavator) or manual beam, which requires pulling on the geomembrane.



Steps:

- hold the geomembrane with blacksmith clamps.
- lay the COLETANCHE with the terphane film in contact with the subgrade.
- place the Coletanche in the direction of the highest slope, starting from the bottom in the case of a basin.

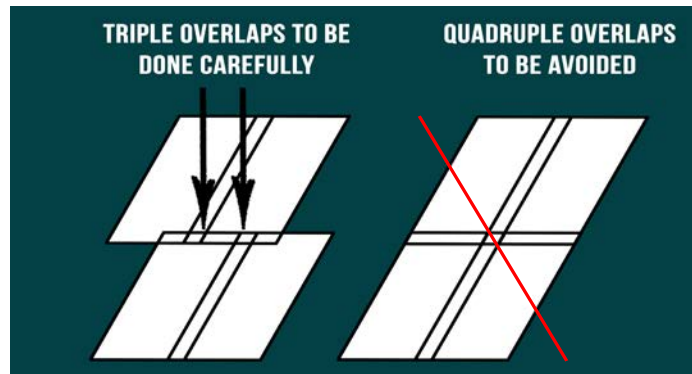
When using a geotextile between the subgrade layer and the COLETANCHE geomembrane, insert a MAT 100 glass mat in line with the areas to be welded, to avoid damaging it.

6.3.3 Overlap width

The overlap width between two strips is 20 cm (indicated by a green line).

6.3.4 Transverse joints

Transverse joints on the slopes are prohibited unless exceptionally required or approved beforehand by the main contractor. Quadruple overlaps due to the alignment of 4 strips are prohibited. Special attention must be given to triple overlaps.



6.3.5 Wind effects and temporary ballasting

Pay particular attention to the ballasting of the strips as they are laid, especially at the end of the day if all the welds are not completed.

Ballast the geomembrane using sand bags of 10 to 20 kg, concrete blocks, filled tyres or non-aggressive materials. They will be evenly distributed on the geomembrane surface, and more particularly in line with the future welds, to fight against the wind effects during the duration of the worksite.

Attach the bags on the slopes by a rope anchored in a slope crest.

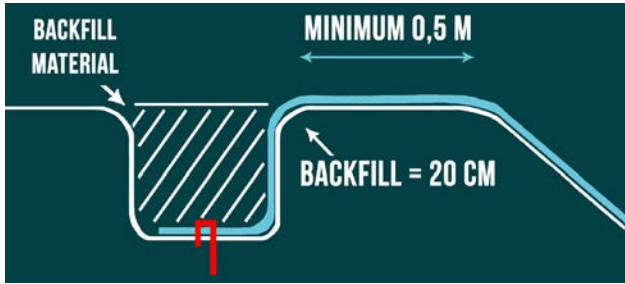
6.3.6 Anchoring at top of slope (the most frequent case)

The geomembrane is positioned and placed in the correctly sized trench (table of indicative values below).

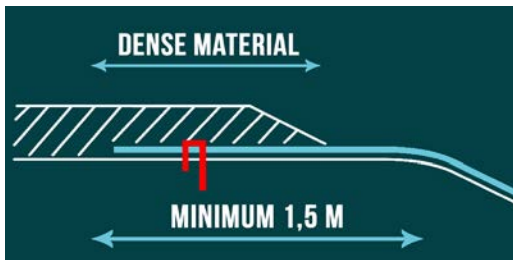
- Pay attention to the slope crest anchorage for proper holding of the geomembrane.
- Make sure there are no creases on the slopes.

The anchoring is then done by covering the geomembrane with a compacted backfill material.

LENGTH OF THE SLOPE	LITTLE OR MODERATE WIND EXPOSURE	STRONG WINDS
m	m ²	m ²
0 to 3	0,04	0,06
3 to 5	0,09	0,16
5 to 15	0,16	0,35
more than 15	0,25	0,36



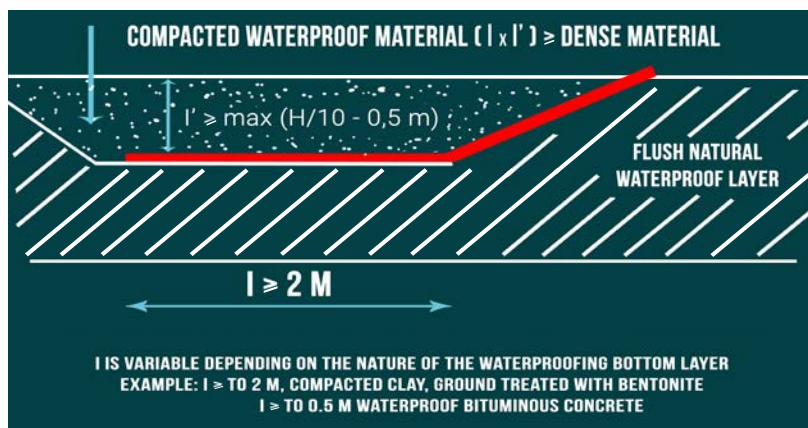
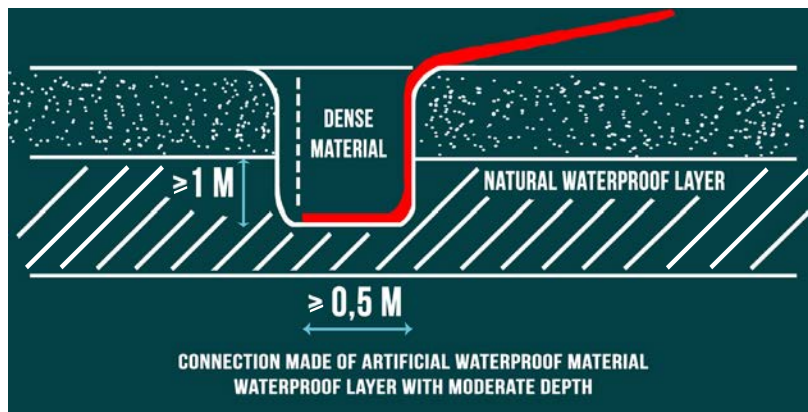
The anchoring is carried out using dense material on the geomembrane previously placed. Special precautions should be taken to avoid erosion over time.



Wait for the earth works to be put in operation so that the geomembrane takes its final position with minimal internal tensions.

6.3.7 Anchoring at the base of slope

Trench anchoring at the slope base may be required to avoid the wind effects and to ensure waterproofing of the geomembrane.



▶ 7. WELDING

7.1 Team and specific equipment

A standard team of welders comprises a welder and a helper for rolling.

The welder manages the whole operation, setting the pace and directing the helper according to the melting conditions of the bitumen.

The helper ensures proper bonding in line with the weld.

Provide the following specific material for the rolling:

- a metal roll of 10 to 15 kg for horizontal sections, of a width of 20 cm.
- a roll of 5 kg for the slopes and specific points.

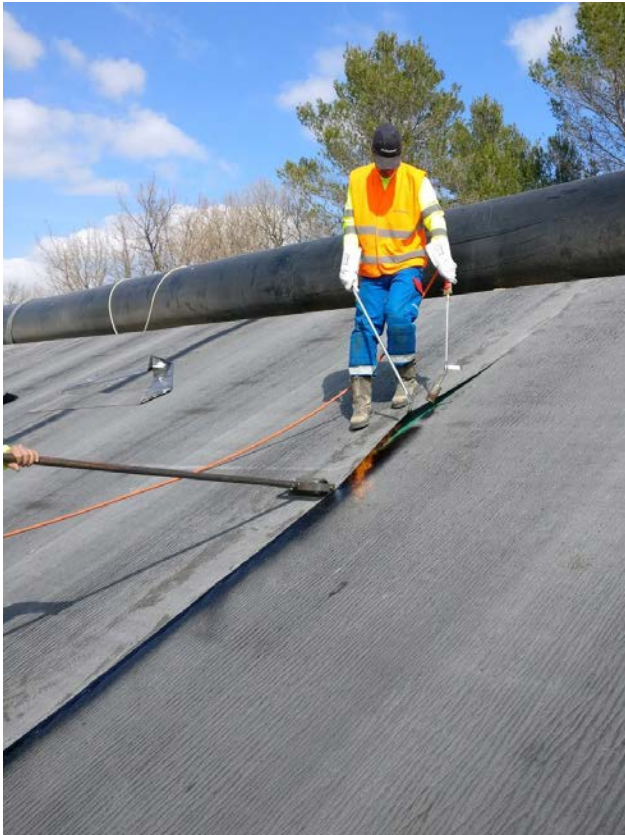
Note: complete installation kits are available on request; please contact us.

7.2 Weather conditions

Do not weld in the presence of water as it vaporises on contact with hot bitumen and forms bubbles that will remain within the seam. Slight dampness is acceptable.

7.3 Technical details of welding

- Carefully brush the seam areas to remove sand that may have accumulated on both sides of the weld area.
- Remove the silicone protective paper from the weld strip.
- Clean the mud traces with a damp sponge.
- Make sure to remove any sharp stones that may still be under the lower layer, as their presence would prevent proper rolling.
- Start by welding an area 50 cm long and roll it thoroughly.
- Then move as evenly as possible, lifting the upper layer about ten centimetres, and insert the torch between the two layers, keeping the flame aligned with the edge to heat the 20-cm width in a single run.
- When rolling, maintain a distance of 1.50 to 2 m from the torch, i.e. about 1 m from the end of the flame.
- Always weld upwards on slopes.
- Roll vigorously to obtain good contact between the two layers.
- Do not step on a hot seam.
- A bitumen bead must flow when rolling over a width of up to 3 cm.
- Visually check the seam once it has cooled down.
- Perform a finishing operation, by warming the edge between the two membranes, to form a scarf joint, possibly using a small trowel.



► 8. CONNECTION TO VARIOUS STRUCTURES, SPECIFIC POINTS

8.1 Preparation of subgrade

Connection details must be carried out during the design phase, and preference must be given to rounded shapes as much as possible.

Backfill compaction must be ensured around specific points to minimise differential settlement.

Adopt appropriate construction measures, as detailed in the drawings, including smooth pipes for intrusions.

8.2 Connections

8.2.1 Connections to concrete structures

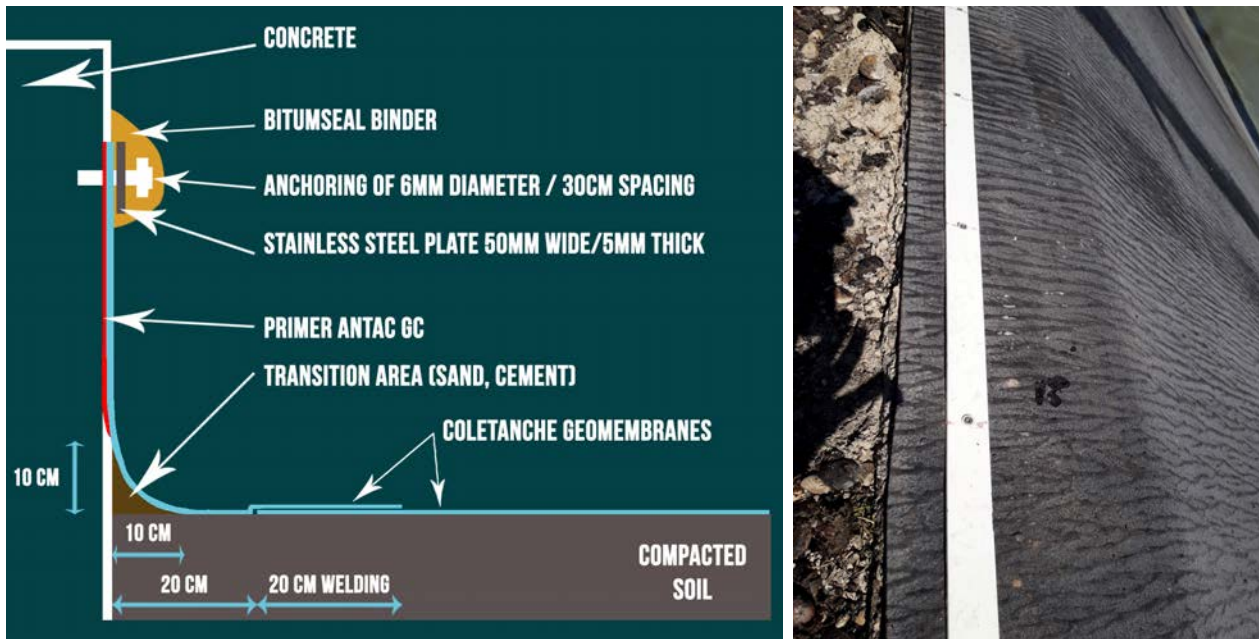
Ensure that the concrete is dry, with at least 28 days of drying, and that it is free of its laitance, possibly by sanding. Then apply a cold primer (ANTAC GC), up to 150 g/m². The ANTAC GC primer must be applied to any material receiving a welded bituminous geomembrane.

After the primer has dried, proceed to classical welding by heating both the geomembrane and the concrete, and by rolling the geomembrane with a damp sponge or cloth.

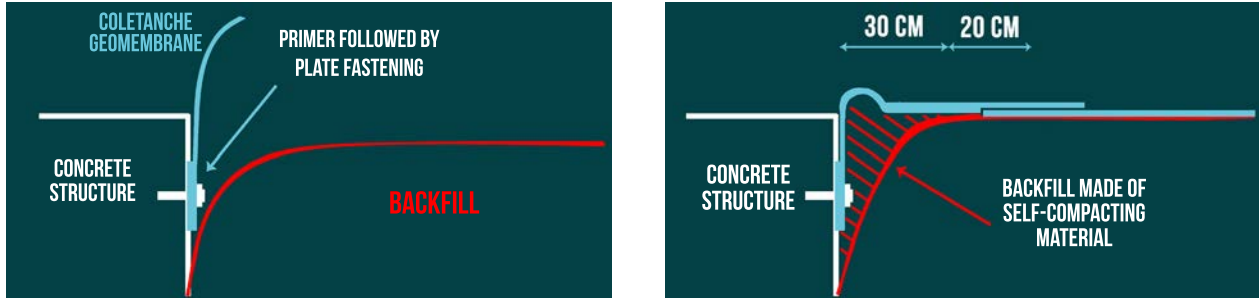
Place a stainless steel, aluminium or plastic plate, tacked or bolted into the concrete to ensure the durability of the connection.

To reinforce the waterproofing, the fasteners may be covered by a COLETANCHE welded joint strip (cut on the site in the geomembrane used in the main part), or by a "Bitumseal" bituminous binder.

VISIBLE GEOMEMBRANE



BURIED GEOMEMBRANE



8.2.2 Connection to water inlets and outlets

Take the same precautions to connect the geomembrane to the water inlet or outlet pipes.

Cast a small concrete block around the pipe head to connect the main layer of the membrane, and then clad the pipe with additional material.

Waterproof the pipe either using a seal (polyurethane) inserted in the concrete block at the time of casting, or by connecting a COLETANCHE sleeve on the pipe, by welding or by bonding using Bitumseal. This connection can then be reinforced using a clamp ring.

9.4 Vacuum bell

The vacuum bell is a means of checking the waterproofing of the weld, but does not provide information on its mechanical strength. This method is recommended for statistical inspection, especially on specific points (triple overlaps).

- wet the edge of the weld with a soap solution,
- apply a depression of 200 to 400 mbar inside a Plexiglas bell® using a vacuum pump, for about twenty seconds,
- observe the appearance of soap bubbles, which reflect air leaks and, therefore, a possible welding defect.

9.5 Ultrasound testing

The principle of this inspection method is to emit ultrasound on the surface of the upper geomembrane seam. If there is a defect, an intermediate echo is detected on the echograph screen.

The most commonly used means is based on a portable ultrasound system, for example the PANAMETRICS EPOCH.

9.6 Dielectric testing

This inspection concerns the entire surface of the geomembrane waterproofing solution. It helps detect the specific passing defects or scale of defect.

9.7 Destructive testing

Last method of inspection: the sampling of welds for the execution of tensile strength tests according to the standard NF P 84 502-1.

A weld is considered compliant if:

FUNCTIONAL THICKNESS (MM)	$2,0 \leq X < 3,0$	$3,0 \leq X < 3,8$	$3,8 \leq X < 4,5$	$4,5 \leq X < 5,2$	$5,2 \leq X$
RESISTANCE (KN/M)	$\geq 10,0$	$\geq 13,0$	$\geq 16,0$	$\geq 18,0$	$\geq 20,0$
OR	or	or	or	or	or
WELD FACTOR	$\geq 80\%$	$\geq 80\%$	$\geq 80\%$	$\geq 80\%$	$\geq 80\%$

Values defined in the ASQUAL Geomembranes v.14 standard

9.8 Repairs

Repair the welds that are declared non-compliant with an additional layer of geomembrane, the dimensions of which will exceed either side of the extent of the fault by 20 cm. Prepare the repair patch by rounding its corners and weld it on its whole surface by carefully compressing by rolling it.

▶ 10. INSTALLATION OF THE PROTECTIVE COVER LAYER

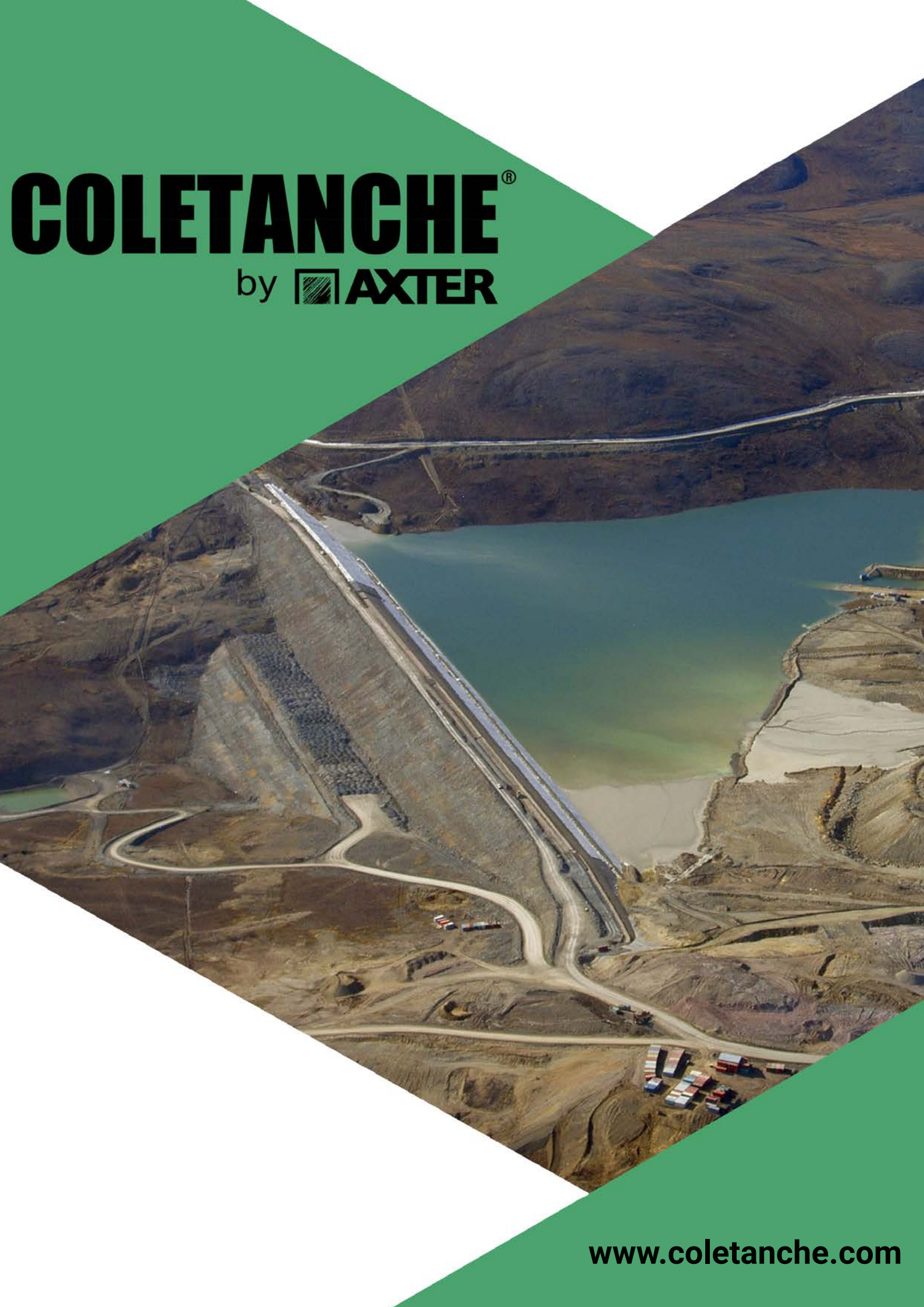
10.1 General precautions

The installation of a protective layer on the COLETANCHE does not create problems if the following points are considered:

- adapt the protective layer to the structure and its future use (risk of erosion, settling, puncture of the layer).
- check the stability of the layer on the geomembrane (risk of sliding off the layer, risk of tension in the membrane under the weight of the layer, abutment at the slope base).

COLETANCHE®

by  AXTER



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