Geosynthetic Linings

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient	✓	Channel Lining	✓	Medium-Long Term	✓
Outlet Control		Soil Treatment		Permanent	✓

Symbol

Photo 1 – Temporary chute lined with filter cloth

Photo 2 – Diversion drain lined with composite wood shaving mat

Key Principles

1. The critical hydraulic design parameter is either the maximum allowable flow velocity or allowable shear stress of the chosen material.
2. The key operational issue is usually the control of surface flow (with respect to location and velocity), and the prevention of water flow under the material.
3. It is very important for porous materials to maintain good contact with the soil. For impervious materials the focus is usually on preventing any water flowing under the material.

Types of Geosynthetics

The types of geosynthetics that can be used as channel liners include:

- non-woven geotextile (e.g. filter cloth);
- woven fabrics, which can include *Erosion Control Mats* and *Sediment Fence* fabric;
- impermeable membrane, such as thin plastic sheeting;
- impermeable netting, such as jute or coir netting coated (after placement) with bitumen;
- permeable and impermeable pocket fabrics, such as grout-filled mattresses;
- corrugated sheet iron;
- bitumen;
- concrete.

The first four materials may also be referred to as “geotextiles”.

Within those materials commonly classified as geotextiles, or geotextile related products, there are various manufacturing processes, some of which are described over-page and shown in Photos 3 to 10.

Knitted	A geotextile produced by inter-looping one or more yarns, fibres, filaments or other elements.
Woven	A geotextile produced by interlacing, usually at right angles, two or more sets of yarns, filaments, tapes or other elements.
Non-woven	A geotextile in the form of a manufactured sheet, web or batt of directionally or random oriented fibres, filaments mechanically and/or thermally and/or chemically bonded.
Composite	Composite geotextiles are combinations of the above and are usually designed to perform specific functions.
Webbing	Webs or webbing are a kind of very coarse woven fabric made of strips a few centimetres wide. Webs look like a very coarse slit film woven fabric. They are typically used for erosion control, bank protection, and soil reinforcement.
Geomat	A three-dimensional, permeable, polymeric (synthetic or natural) structure made of bonded filaments. These very open structures have a typical thickness of 10 to 20mm. (Not to be confused with the term *Erosion Control Mats*)
Net/mesh	Two sets of coarse parallel fibres intersecting with a constant angle (generally between 60° and 90°). Typically organic in origin, the two sets of fibres are connected by alternate weaving. Typically, the fibres are 1 to 5mm in thickness, and the size of opening is from a few millimetres to several centimetres.
Geonet	A planar, polymeric structure consisting of a regular dense network, whose constituent elements are linked by knots or extrusions and whose openings are much larger than the width of the constituents. Typically, the size of strands is 1 to 5mm and the size of opening is from a few millimetres to several centimetres. Geonets are used for soil reinforcement and fabricating gabions. They can also be combined with woven or non-woven geotextiles acting as filters to form a drainage structure.
Geogrid	A planar, polymeric structure consisting of a regular open network of integrally connected tensile elements, which may be linked by extrusion, bonding or interlacing. Geogrids are typically used for soil reinforcement.
Honeycomb	A three-dimensional, permeable, polymeric (synthetic or natural) honeycomb or web structure, made of strips of geotextile or geomembranes linked alternately. These structures are typically used to confine soil into cells to provide soil reinforcement and erosion control.
Geosynthetic	A planar polymeric material used in contact with soil or rock.
Geotextile	A planar, permeable, polymeric, woven, non-woven or kitted textile used in contact with soil or rock.
Geocomposite	A manufactured material using at least one geosynthetic product among the components. Typical examples are used to form prefabricated subsoil drainage products.

Some products, such as geonets, geogrids and honeycomb materials, need to be incorporated with other materials in order to form a channel lining. Geonets and geogrids can be used as an anchoring system for some low-strength blankets, while honeycomb grids can be used with aggregate to form a protective surface.

For design information on *Erosion Control Mats*, refer to the separate fact sheet.

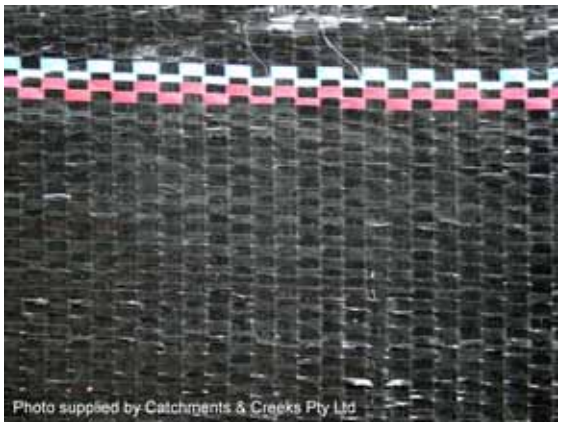

Photo 3 – Woven fabric

Photo 4 – Non-woven fabric

Photo 5 – Composite

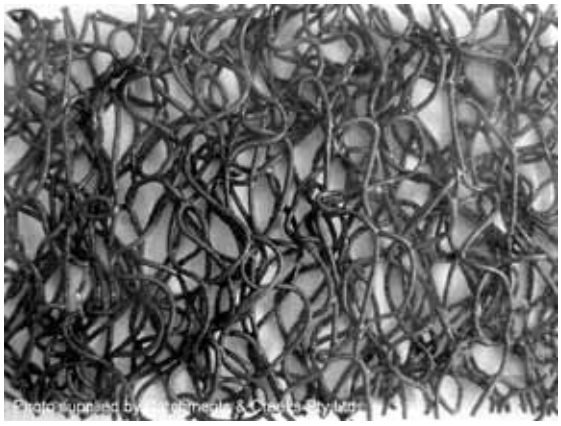

Photo 6 – Geomat

Photo 7 – Net (mesh)

Photo 8 – Kitted geogrid

Photo 9 – Extruded geogrid

Photo 10 – Honeycomb geocell

Description

Geosynthetics include any synthetic material incorporated into geotechnical engineering related material as an integral part of a manufactured structure or system.

Geotextiles include any knitted, woven, or non-woven textile material formed in a laboratory or a chemical plant as opposed to those of natural origin.

Fabrics include the planar (laying in one plane) geotextiles produced by interlacing yarns, fibres, or filaments.

Fabrics can be either surface-laid or buried. Surface-laid fabrics include impervious materials used to cover bare soil, and pervious mats used with or without the incorporation of vegetation (grasses).

Buried geosynthetics (not addressed in this fact sheet) can be used to improve the long-term performance of vegetation and to provide root reinforcement.

Purpose

Geosynthetic linings provide protection to both temporary earth drains, and permanent vegetated and non-vegetated drainage channels and chutes.

In high velocity areas, buried geosynthetic mats can be used to reinforce grass-lined channels.

Limitations

Geosynthetics are usually best incorporated with vegetation.

Non-biodegradable products have limited use in fauna inhabited bushland areas.

Biodegradable mats generally have a lower allowable velocity limit.

Impermeable material should be considered on highly dispersive soils.

Advantages

Quick installation.

Wide variety of products and uses.

Most products provide instant erosion protection.

Can be used for emergency repairs.

Products are available for both short and long-term uses.

Disadvantages

Some fabrics have a very limited working life.

Some environmental problems associated with non-biodegradable fabrics used in bushland areas.

Maintenance problems associated with some buried mats.

Bitumen-based products can release phosphorus to receiving waters.

Common Problems

Operational life of the chute or drain extends beyond the appropriate service life of the effective lining material. Some, non UV-stabilised geosynthetics such as polypropylene have a service life of less than 3-months in Australian conditions.

Inappropriate inlet geometry causes inflow to bypass the drain resulting in erosion.

Water flow and erosion under the channel liner.

Erosion and/or natural settlement along the sides of long-term, hard surface linings, such as concrete, can result in water being deflected by the now-elevated up-slope edge of the lining material.

Special Requirements

Upper edge of flexible linings **must** be well secured (buried and pinned) in an anchor trench.

Porous fabrics **must** only be used on non-dispersive soil.

Good subsoil drainage and foundations are required to stabilise impervious chute and channel linings.

Four general requirements exist for effective protection against erosion:

- good contact must be achieved;
- seepage flow under the channel liner should be discouraged;
- surface irregularities removed; and
- good anchorage must be provided.

Particular attention should be given to the crest, toe and sides to avoid erosion and uplifting.

Site Inspection

Check flow entry conditions to ensure no bypassing, undermining, sedimentation, or erosion.

Ensure the outlet is appropriately stabilised.

Ensure the drainage chutes are straight.

Check for erosion around the edges of the surface lining material.