



Topic 6 WATERPROOFING

Part 2: What are the different types of waterproofing materials?

The modern-day waterproofing materials are as follow:

- Bitumen waterproofing materials
- Epoxy polyurethane, etc. types of resin waterproofing materials
- Cement waterproofing materials
- Rubber waterproofing materials
- Silicone-based waterproofing materials

Bitumen Waterproofing Materials

Bitumen, which is a hydrocarbon compound, is obtained today in refineries from crude oil. Bituminous materials are organic materials that are black in colour. Bitumen is used as a waterproofing material due to its water resistant and insulating properties. Basic components: asphalt, resins and oils.

Mixing bitumen with natural or artificial mineral fillers is called asphalt. The chemical structure of bitumen is 75-80% C (Carbon), 7-12% H (Hydrogen), 0-1% N (Nitrogen), 1-7% S (Sulphur) and 0, -5% O (Oxygen). The higher the content of carbon and hydrogen is, the better the bitumen.

Carbon to hydrogen ratio (C/H):

- >0,8 – asphalt
- 0,4-0,8 – resin
- <0,4 – oils

Epoxy Waterproofing Materials

The name Epoxy is a combination of the Greek words Epi (On) and Oxy (Sharp/acidic). Epoxy materials are adhesive chemical resins highly resistant to acids and alkali external factors. They can be used as final surface coating and paint primer materials. Epoxy is generally two-component material – a binder and a hardener. Its abrasion resistance and tensile strength are very good. It is not affected by temperature differences and it can be used wherever high strength is required.



Figure 1. Epoxy based waterproofing application

Cement Waterproofing Materials

The main raw materials used for the production of cement are limestone and clay. Cement is a hydraulic binder material. The materials needed in cement production are obtained from their natural environment. This mixture is called “raw meal”. The “raw meal” is then heated to the point of liquefaction at about 1500°C in a rotary kiln.

The main types of cement are:

- Portland cement
- Portland slag cement (cement + ground granulated slag)
- Pozzolana cement
- Blended cement

Other types of cement are: Fly Ash Cement, Super Sulphate Cement, Sulphate Resistant Cement, High Early Strength Cement and Low Hydration Heat Cement Sulphates Resisting Cement, Rapid Hardening Cement, Low Heat Cement, etc. Cement is mainly used for making concrete and cement-lime plaster.

Rubber waterproofing materials

Rubber in its modern version is obtained synthetically in industrial installations. By adding sulphur to it, its properties are improved as well as its resistance to temperature differences. Rubber can be mixed with paint, hardeners, kaolin and others. Waterproof rubber materials can be liquid products or membranes. Liquid products are applied by means of a brush, roller, or praying. Membranes are manufactured in rolls.

Silicone-based Waterproofing Materials

The word silicon refers to a chemical bond in the form of Si-O-Si (i.e., the bond made by silicon atoms with oxygen is called silicon). Silicone-based Waterproofing Materials possess good adhesive properties, flexibility and durability. Depending on the quality expected from the product, many of these characteristic features can be improved.

Silicone-based Waterproofing Materials can be used for surface insulation.

In this way, the toughness, the resistance to moisture, and chemicals of a surface is increased. Besides that, the surface is protected against UV rays.

Acrylic Waterproofing Materials

It is possible to produce acrylics with different physical properties (colour, transparency and toughness). Plexiglass is the most common acrylic product. It is used in waterproofing. It is resistant to UV rays. It can be used in wet areas, terraces, etc.

Polymer Waterproofing Materials

Large organic molecules are called polymers. Polymers are divided into natural, semi-synthetic and synthetic. For example, rubber and cellulose are natural polymers. Polymers are generally synthetically produced and they originate from petroleum. Polystyrene and polyethylene are the most well-known synthetic products. In addition, synthetic forms such as PET (Polyethylene terephthalate), LDPE (Low Density Polyethylene), HDPE (High Density Polyethylene), PVC (Polyvinyl Chloride), PP (Polypropylene), PS (Polystyrene) and Polytetrafluoroethylene (Teflon) are also



available. Synthesized thermal insulation sheets that are modified with polymers are called bituminous modified membranes.

Bitumen-based Membrane Materials

Polymer bituminous membranes may be produced as:

- Polyethylene coated on both sides
- Both sides covered with fine sand
- One side is polyethylene-covered, while the other is fine sand-covered
- One side is polyethylene-covered, while one side is mineral-covered
- One side is fine sand-covered, while the other is mineral-covered
- One side is polyethylene-covered, while the other is metal foil-covered
- One side is fine sand-covered, while the other is metal foil-covered.

Synthetic Membrane Materials

PVC and TPO membranes are welded by hot air by their edges. This overlapping at the junction of the sheets provides excellent protection against ingress of water, as both sheets form a monolithic surface, which forms a complete and durable roof-membrane system.

- **PVC cover membranes** are products that have been in use since the 1960ies and have been known for their longevity for many decades. They are more plastic and flexible than TPO membranes. There is a possibility to choose the colour of the membrane. PVC membranes are welded together by hot air by their edges. This overlapping provides excellent protection against ingress of water, as both sheets form a monolithic surface, which forms a complete and durable roof-membrane system. Since they are more susceptible to microorganisms, special membranes are used on such types of roofs. According to their manufacturing specifications, PVC membranes are fire resistant as well. They are not compatible with bitumen-based and other crude oil-based products such as EPS and XPS thermal insulation boards/sheets. PVC membranes can be recycled and used for the manufacturing of lower-class products.
- **TPO membranes** – although TPO membranes are one of the latest high-tech solutions, they have proved their importance. They are flexible. However, they are not comprised of plasticizers, which makes them harder than PVC membranes. In comparison with PVC membranes, TPO membranes are more resistant to microorganisms. Therefore, there is no need to design new special ones for such applications. Their fire resistance has been improved through additives. TPO membranes are compatible with bitumen, which makes them ideal not only for new architectural projects but also renovation projects. TPO membranes are welded together by hot air by their edges. This overlapping provides excellent protection against ingress of water, as both sheets form a monolithic surface, which forms a complete and durable roof-membrane system. In comparison with dark-coloured synthetic rubber membranes or bituminous-based thermal insulation membranes, the TPO membranes that are produced in white or other light colours (reflective TPO membranes) can help minimize electricity costs. When white or light-coloured TPO roof systems are used on buildings, heat absorption has plummeted down. TPO membranes can be recycled and are considered ecologically friendly and long-lasting. They do not contain harmful chlorides.
- **Ethylene propylene diene monomer (EPDM)** – is a single-ply synthetic rubber membrane made from ethylene propylene diene monomer (EPDM) mixed with carbon black, oils, vulcanizing and auxiliary substances. The material is pressed into large sheets and vulcanized.



EPDM can be delivered in sheets up to 15 m wide and 61 m long. As a result, fewer joints are needed for installation in temperatures between -23°C and +35°C. One of the most important advantages of EPDM rubber is its ability to preserve its properties in the open and to keep a service life of more than 50 years. The components of EPDM rubber show a lower degree of aging and abrasion. EPDM stays flexible in temperatures up to -45°C; it is unbeatable in terms of elasticity – can be stretched to over 300%, adjusting to the movements of the building and the changes in temperature. The EPDM rubber membrane is lightweight. In addition, the EPDM rubber membrane is exceptionally strong and resistant to tear, perforation or decomposition by chemical agents. Its tensile strength is over 9 N/mm². EPDM is a material with a good eco balance both in the process of manufacture and its applications. No toxic substances are released from the membrane, which allows the collection and use of rainwater. The installation of the membrane is carried out by means of a lightweight system for mechanical fastening, without perforations of the membrane. It is developed on the basis of a tape of reinforced EPDM membrane, combining two self-adhesive tapes on the edges of the membrane along the entire length of the tape. The tapes are placed on the surface and then are manually attached. The distance between the tapes varies depending on the wind load calculations. After that the EPDM sheets are glued to the manually attached tapes. The adjoining EPDM sheets overlap at a minimum distance of 100 mm.

Liquid Membranes (sliding-based application)

The term 'sliding-based' application is used to summarise the waterproofing methods of applications performed by means of direct coating on different surfaces, including all liquid and cementitious Waterproofing. Waterproofing of the surface with sliding-based applications is one of the most popular methods used in building construction. When applied, liquid waterproofing membrane forms a seamless coating which prevents weak areas or potential cracks in the waterproofing layer. An advantage of slide-based waterproofing is that it is suitable for application by amateurs – it is applied with a brush, trowel or roller to the surface. It can be one-component or two-component. The former is applied directly, while with the latter the two components are mixed together with the help of an electric mixer to obtain a homogeneous mixture.

Types of liquid-applied membrane (LAM):

- Cementitious Waterproofing
- Bituminous Coating Waterproofing Method
- Bituminous Membrane Waterproofing Method
- Polyurethane Waterproofing