

COMPARATIVE STUDY OF WATERPROOFING CHEMICALS ON NORMAL CONCRETE

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Abstract: This report is about the project work which includes study of water proofing of concrete. The study of different chemicals used for waterproofing of concrete and their comparison with the normal concrete.

The study also includes the properties of Ultratech Weatherplus cement concrete and the various admixtures used for the water proofing technique.

It comprises of different test for different building material such as aggregates (coarse & fine aggregates), concrete and cement. The report also includes study of water absorption property of different types of cement concrete.

The study also includes the design of concrete mix and the various tests of the materials used for the project work.

Index Terms - Water Proofing, Concrete, Water Repellent Chemicals, Ultratech Weatherplus Cement, SBR, Polyurea.

1. INTRODUCTION

1.1 Water proofing of concrete

Waterproofing in buildings is the formation of an impervious barrier over surfaces of foundations, roofs, walls and other structural members of building to prevent water penetrations through these surfaces. The building surfaces are made water-resistant and sometimes waterproof.

Waterproofing in buildings and structures are generally required for basement of structure, walls, bathrooms and kitchen, balconies, decks, terrace or roofs, green roofs, water tanks and swimming pools etc.

Waterproofing of concrete structures is done by either suitable extraneous treatments like applying paints, fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints.

Commonly used materials for waterproofing in building is cementitious material, bituminous material, liquid waterproofing membrane and polyurethane liquid membrane etc.

1.2 Why we need water proofing of Concrete?

Waterproofing concrete is essential to prevent water intrusion and structural damage. It is also required to protect the structural contents from water infiltration that can cause structural damage to the concrete or corrosion to the imbedded steel. Concrete is by design a porous material, and water can pass through it by hydrostatic pressure, water vapor gradient or capillary action. Water can also enter at cracks, structural defects or at improperly designed or installed joints.

Waterproofing is also required to eliminate deterioration to the concrete that can occur from exterior and interior chemicals that are present at the building site. Alternate wetting and drying can be harmful to the concrete structure and can result in destruction due to alkali-aggressive reaction. The deposit that results may be the original substance or it may be some reaction that is formed in the concrete. The result is efflorescence that is seen on the concrete walls, brick or stone.

1.3 Chemicals used for water proofing:

1.3.1 Styrene-Butadiene Rubber (SBR):

SBR describe families of synthetic rubbers derived from styrene and butadiene. These materials have good abrasion resistance and good aging stability when protected by additives. SBR is often used as part of cement based sub-structural (basement) waterproofing systems where as a liquid it is mixed with water to form the Gauging solution for mixing the powdered Tanking material to slurry. SBR aids the bond strength, reduces the potential for shrinkage and adds an element of flexibility.

1.3.2 Polyurea:

Polyurea is a type of elastomer that is derived from the reaction product of an isocyanate component and a synthetic resin blend component through step-growth polymerization. Its fast reactivity and relative moisture insensitivity made it useful for coatings on large surface area projects, such as secondary containment, manhole and tunnel coatings, tank liners, and truck bed liners. Excellent adhesion to concrete and steel is obtained with the proper primer and surface treatment. They can also be used for spray moulding

and armour. Some polyurea reach strengths of 6000 psi (40 MPa) tensile and over 500% elongation making it a tough coating. The quick cure time allows many coats to be built up quickly.

2. RESEARCH METHODOLOGY

2.1 Objective of work:

The objective of the work is to prepare concrete which is water repellent up to some extent so as to reduce seepage and early deterioration of buildings.

The feeling amongst many people is that waterproofing is costly and unnecessary. However costly remedial action becomes a painful lesson for many. Because of its relative porosity, concrete can allow water and other chemical to infiltrate it. Left unattended, this can lead to the deterioration of a building.

The source of the vast majority of foundation problems is water. Apart from burning down, perhaps the worst thing that can happen to a residential structure or a building is a foundation problem. Wet soil beneath a foundation can swell or lose strength. This is one of the reasons to always keep the foundation dry. It is worth remembering that doing it right the first time is critical, because coming back to fix it is costly affair.

It is therefore advisable that concrete is waterproofed. However, choosing the best way to waterproof the concrete has continued to be a daunting task to most developers. Ensuring that water passage in a concrete is prevented and hydrostatic pressure resisted, a concrete can be waterproofed from the positive (exterior) side, negative (interior) side or from within the concrete itself (integral systems).

2.2 Materials used:

2.2.1 Cement:

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Cement is the most widely used material in existence and is only behind water as the planet's most-consumed resource.

Tests of cement:

- Color Test of Cement
- Presence of Lumps
- Cement Adulteration Test
- Temperature Test of Cement
- Float Test
- Initial and final setting time

2.2.2 Aggregates:

Aggregate is a term for any particulate material. It includes gravel, crushed stone, sand, slag, recycled concrete and geosynthetic aggregates. Aggregate may be natural, manufactured or recycled. Aggregates make up some 60 -80% of the concrete mix. They provide compressive strength and bulk to concrete.

Aggregates in any particular mix of concrete are selected for their durability, strength, workability and ability to receive finishes.

Tests of aggregates:

- Surface moisture content & absorption
- Bulking of sand
- Sieve analysis
- Toughness of aggregate
- Durability of aggregate
- Shape of aggregate
- Fineness modulus

2.2.3 Concrete:

Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens over time—most frequently in the past a lime-based cement binder, such as lime putty, but sometimes with other hydraulic cements, such as a calcium aluminate cement or with Portland cement to form Portland cement concrete (for its visual resemblance to Portland stone). Many other non-cementitious types of concrete exist with different methods of binding aggregate together, including asphalt concrete with a bitumen binder, which is frequently used for road surfaces, and polymer concretes that use polymers as a binder.

Tests of concrete:

- Slump cone test
- Compressive strength test
- Water absorption test
- Initial surface absorption test

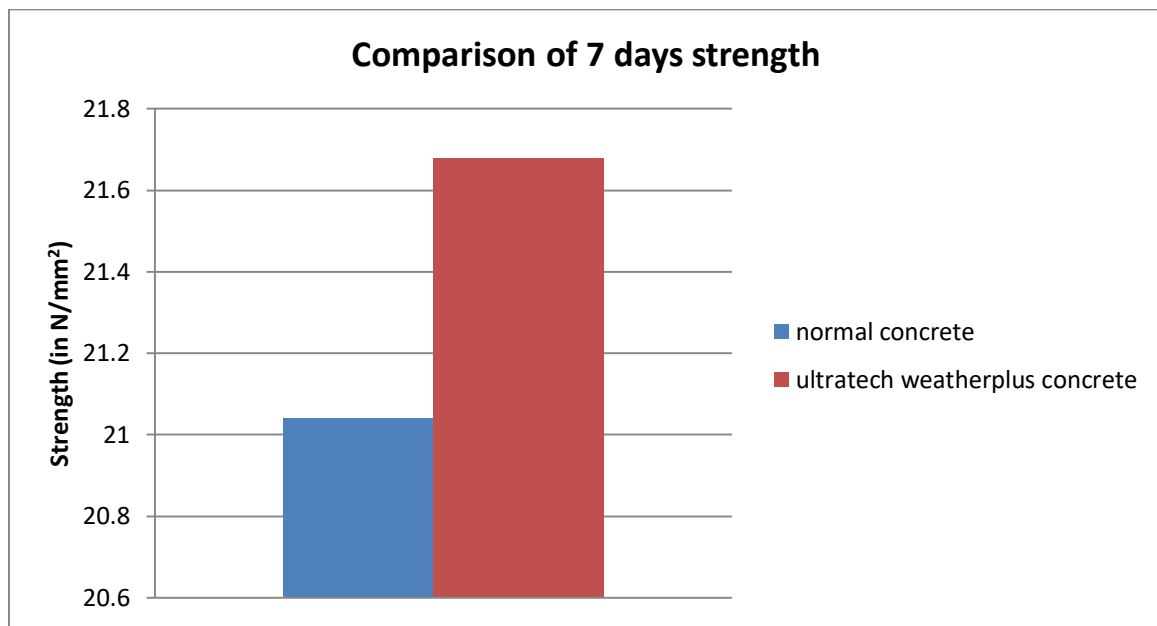
3 RESULTS

3.1 Comparison of normal and Ultratech weatherplus cement concrete

3.1.1 Comparative result of 7-days compressive strength of Normal Concrete and Ultratech Weatherplus Concrete for M30 grade

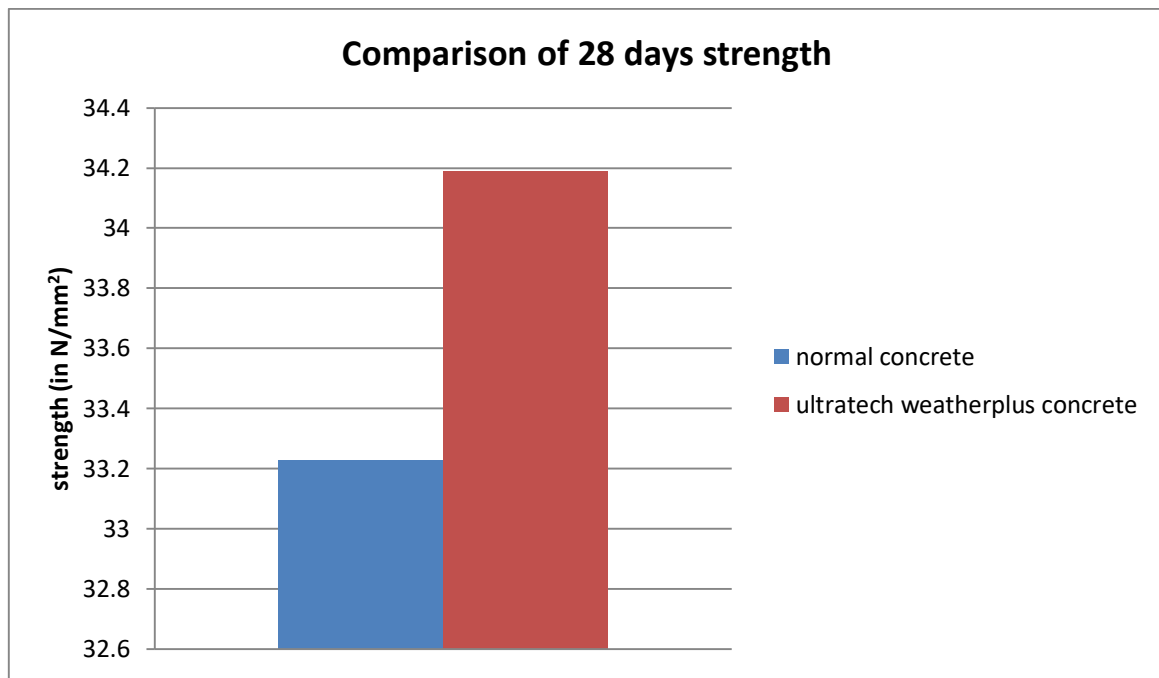
Table 4.1 Normal Concrete / Weatherplus Concrete

Types of concrete / Concrete block	Block 1 (in N/mm ²)	Block 2 (in N/mm ²)	Block 3 (in N/mm ²)	Average strength (in N/mm ²)
Normal Concrete	21.33	21.15	20.66	21.04
Ultratech Weatherplus concrete	21.5	21.33	22.22	21.68



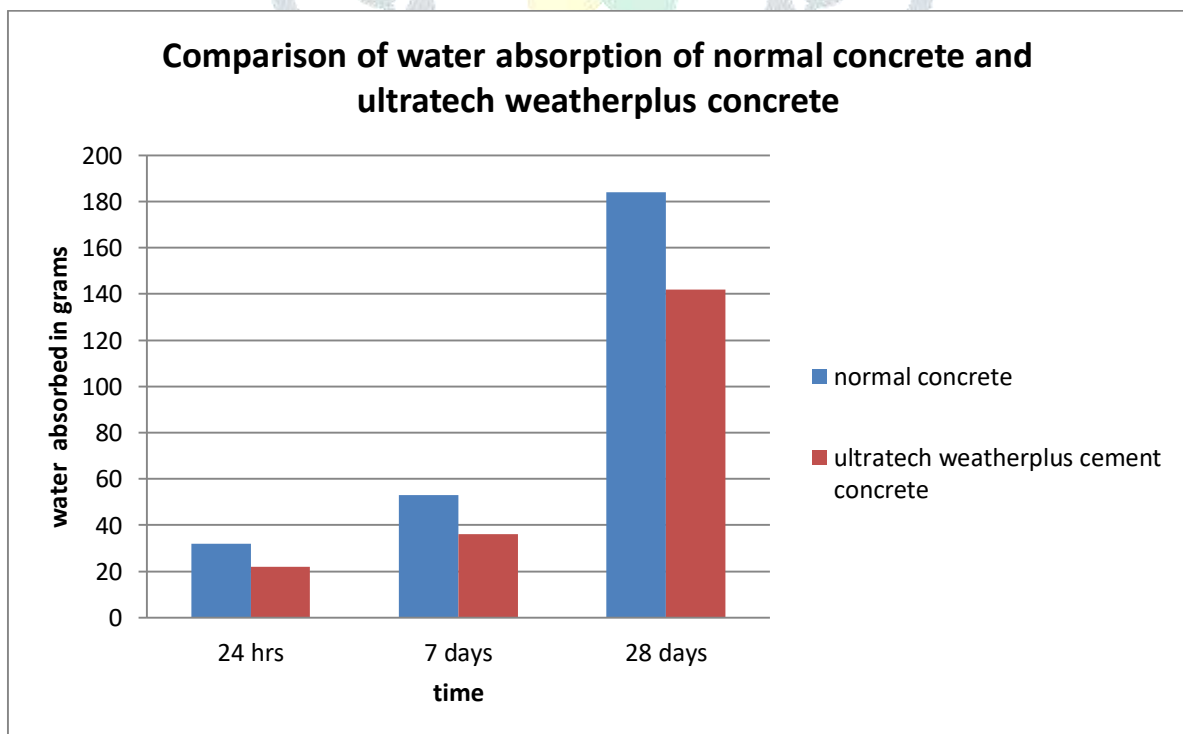
3.1.2 Comparative result of 28 day compressive strength of Normal Concrete and Ultratech Weatherplus Concrete for M30 grade

Types of concrete / Concrete block	Block 1 (in N/mm ²)	Block 2 (in N/mm ²)	Block 3 (in N/mm ²)	Average strength (in N/mm ²)
Normal Concrete	33.2	34.12	32.36	33.23
Ultratech Weatherplus concrete	34.15	33.88	34.56	34.19



3.1.3 Comparative result of water absorption of Normal Concrete and Ultratech Weatherplus Concrete for M30 grade

Types of concrete/ Concrete block	Concrete block				Percentage water absorption		
	Initial weight	Water absorbed in 24hrs	Water absorbed in 7 days	Water absorbed in 28 days	Water absorbed in 24hrs	Water absorbed in 7 days	Water absorbed in 28 days
Normal Concrete	8.4kg	32 gms	53 gms	184 gms	3.8%	6.30%	21.90%
Ultratech Weatherplus concrete	8.45kg	22gms	36gms	142gms	2.60%	4.26%	16.80%

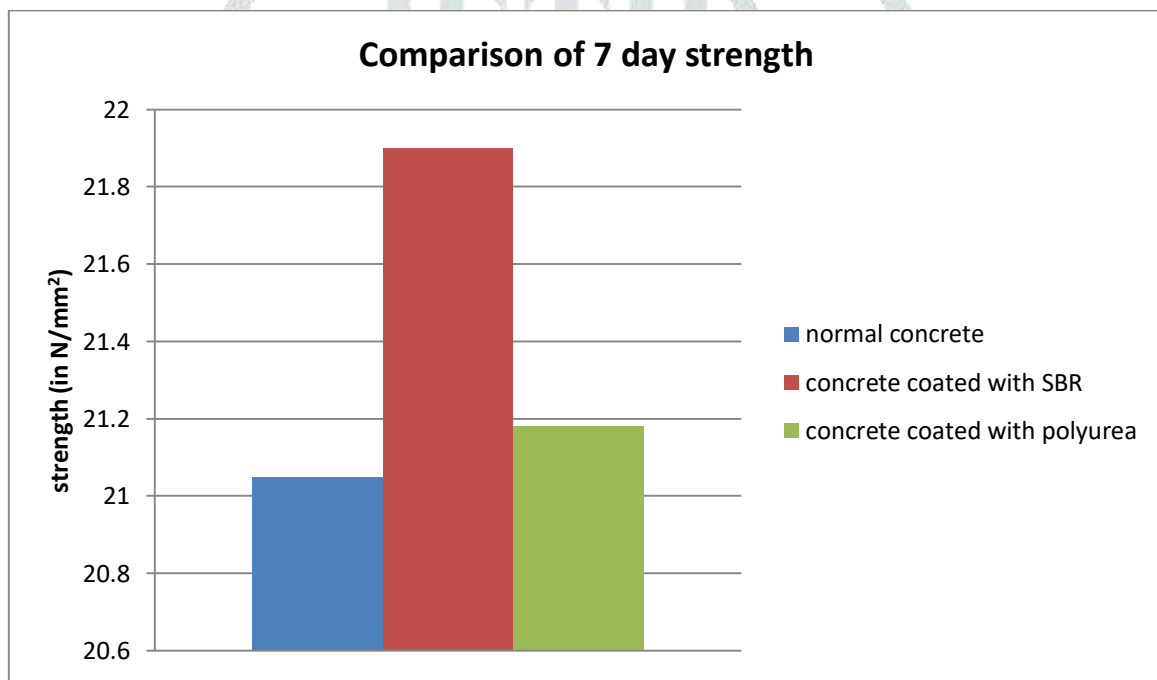


Comparative result:

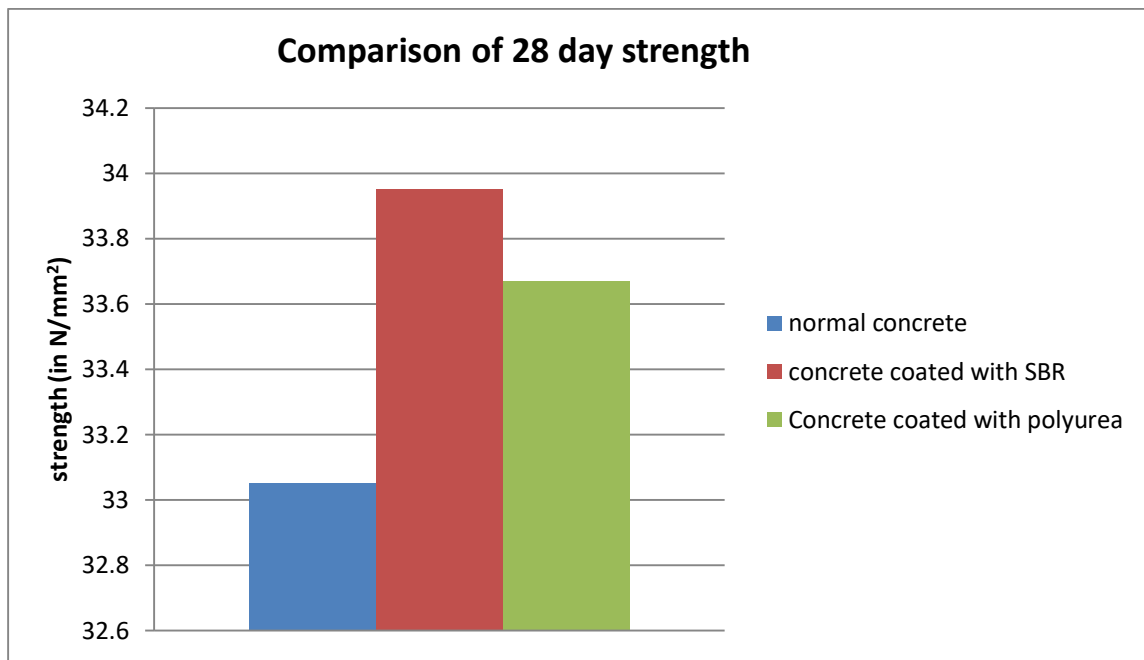
Weatherplus cement concrete cube	Normal cement concrete cube
Strength after 7 days of curing is 21.768 N/mm ² .	Strength after 7 days curing is 22.04 N/mm ² .
Strength after 28 days of curing is 34.19 N/mm ² .	Strength after 28 days of curing is 33.23 N/mm ² .
Water absorbed in 7 days (by mass) 19.88%.	Water absorbed in 7 days (by mass) 21.90%.

3.2 Comparative results of normal concrete and concrete coated with chemicals**3.2.1 Comparison of 7 days compressive strengths:**

Types of concrete / Concrete block	Block 1 (in N/mm ²)	Block 2 (in N/mm ²)	Block 3 (in N/mm ²)	Average strength (in N/mm ²)
Normal Concrete	21.04	21.45	20.67	21.05
Concrete coated with SBR	21.67	21.87	22.16	21.90
Concrete coated with polyurea	22.34	20.21	21	21.18

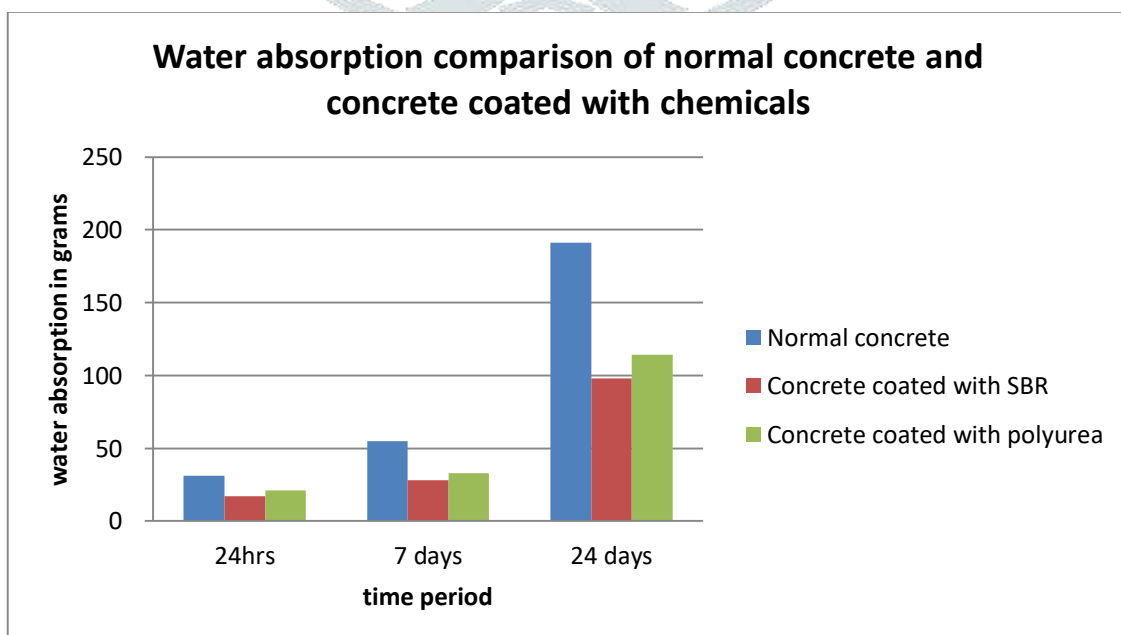
**3.2.2 Comparison of 28 days compressive strengths:**

Types of concrete / Concrete block	Block 1 (in N/mm ²)	Block 2 (in N/mm ²)	Block 3 (in N/mm ²)	Average strength (in N/mm ²)
Normal Concrete	33.32	32.67	33.16	33.05
Concrete coated with SBR	33.68	34.54	33.65	33.95
Concrete coated with polyurea	33.43	34.33	33.23	33.67



3.2.3 Comparison of water absorption:

Types of concrete/ Concrete block	Concrete block				Percentage water absorption		
	Initial weight	Water absorbed in 24hrs	Water absorbed in 7 days	Water absorbed in 28 days	Water absorbed in 24hrs	Water absorbed in 7 days	Water absorbed in 28 days
Normal Concrete	8.5kg	31 gms	55 gms	191 gms	3.64%	6.47%	22.47%
Concrete coated with SBR	8.48kg	17 gms	28 gms	98 gms	2%	3.30%	11.55%
Concrete coated with polyurea	8.53kg	21 gms	33 gms	114gms	2.46%	3.86%	13.36%



3.3 Cost Estimation for coatings:

3.3.1 Styrene butadiene rubber (SBR)

Chemical required for coating of 1 concrete block 28 grams.

Area of block = 0.135m²

Cost of chemical per litre = 180 Rs

Cost of chemical required for 1 block = 5.04 Rs

Cost of chemical required for 1 m² = 37.33 Rs

3.3.2 Polyurea

Chemical required for coating of 1 concrete block 29 grams.

Area of block = 0.135m²

Cost of chemical per litre = 200 Rs

Cost of chemical required for 1 block = 5.80 Rs

Cost of chemical required for 1 m² = 42.96 Rs

3.3.3 Cost comparison for slab casting by Ultratech weatherplus concrete and chemically coated slab**Slab casting by normal concrete (M30 concrete) with SBR coating:**

Cost of 2.76kg of cement used = 19.32 Rs

Cost of 2.07kg of sand used = 1.45 Rs

Cost of 4.15kg of aggregate used = 3.32 Rs

Cost of coating done by SBR (only on one surface) = 0.84 Rs

Total costing for casting and coating = 24.93 Rs

3.3.4 Slab casting by normal concrete (M30 concrete) with polyurea coating:

Cost of 2.76kg of cement used = 19.32 Rs

Cost of 2.07kg of sand used = 1.45 Rs

Cost of 4.15kg of aggregate used = 3.32 Rs

Cost of coating done by SBR (only on one surface) = 0.96 Rs

Total costing for casting and coating = 25.05 Rs

3.3.5 Slab casting by Ultratech weatherplus concrete (M30 concrete):

Cost of 2.76kg of cement used = 22.35 Rs

Cost of 2.07kg of sand used = 1.45 Rs

Cost of 4.15kg of aggregate used = 3.32 Rs

Total costing for casting and coating = 27.12 Rs

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