# CONSTRUCTION CHEMICALS

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## ❖ Construction Chemicals

The history of the construction Industry dates back to the early days of civilization, when people would trade their strength and ability to build crude structures for something else of value. From civilization to civilization, for over thousands of years the quest for living in comfort had a fast growth. Structures made out of stone, clay, timber, lime, masonry have now been transformed to modern concrete constructions.

The history of the construction industry over the past 200 years has been rapidly changing, in large part due to the technological advances starting with the Industrial Revolution and the explosive growth of the global population.

The history of the construction industry was changed with the creation of factories and improvements in metal working in the late 18th and early 19th centuries. These improvements meant there was less work that had to be done by hand, rapidly increasing the rate at which buildings could be completed.

With the creation of new materials like steel and concrete, the history of the construction industry altered again. Concrete is a material cheap enough to be used for virtually any type of project and is strong and durable. Steel provides the strength needed for the interior of large scale building projects, with concrete providing much of the outside support that would not have been done with the older materials.

With the growth of population, cities were created and the needs of the people were changed. People wanted the buildings to grow taller, bridges across rivers, factories etc. Not been an exception, engineers and scientists have always been forced to find the solutions for peoples' inherent need for better, faster and more convenient way of life.

In present day constructions, in addition to looking for stronger and more durable materials, the desire for esthetically attractive constructions is considered important.

In order to fulfill these overwhelming multifaceted requirements scientists are in search for technologically more advanced materials. Cement is an invaluable material in present day constructions which has a history for over centuries. From the present day context,

cement is an irreplaceable material due to its uniqueness in mouldability, availability and low cost etc. In construction in particular the developments in concrete related technology is considered vitally important.

The role played by the chemical industry towards the future of the construction industry is tremendous. Construction chemicals consist of many allied fields that essentially supports structurally, its durability, buildability, usage convenience and aesthetic requirements.

## ❖ Construction chemicals

Construction chemicals basically consist of the following areas although they are not limited to them.

- Concrete Admixtures
- Waterproofing materials
- Concrete Repair/ Grouts- Cementitious, Polymer modified
- Industrial Flooring- Cementitious Dry shake, Polymer
- Sealants- Polysulphides, Polyurethanes, Silicone
- Bonding agents- SBR, Acrylic
- Anchoring materials-Epoxy
- Other related materials such as curing agents, Mould release agents, surface retarders, expansive agents, etc

## ❖ Concrete Admixtures

- Mineral Admixtures
- Chemical admixtures

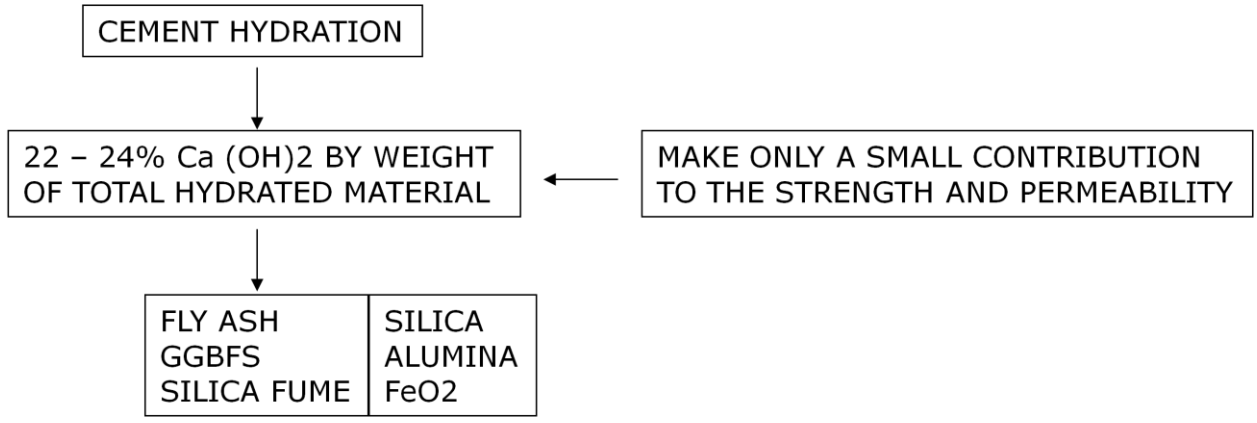
## ❖ Mineral Admixture

- Fly Ash
- Silica Fume
- GGBFS

- Natural Pozzolans

## ❖ Common Properties of mineral admixtures

- Similar or smaller than cement particles
- Replace cement and thereby reduce the heat of hydration.
- Not binders by themselves
- Rich in Silicates and Aluminates
- Reactive in alkyl media




## ❖ Fly Ash

- By product of coal power plants
- Artificial Pozzolana
- Fineness : 250 – 600 $m^2$ / kg
- Specific Gravity: 2.35
- Reacts with Ca(OH)2 in cement
- Class F – Mainly Silicious Min Silica, Alumina , $Fe_2O_3$ - 70%
- Class C – High Lime Ash

## ❖ Micro Silica

- Silicon Dioxide (SiO2) – Amorphous > 85% from Silicon metal Alloys
- Silicon Dioxide (SiO2) – Amorphous < 85% from Ferro Silicon Metal Alloys
- Silicon Dioxide (SiO2) - Crystalline < 0.05%

- Colour - Gray to medium gray powder
- Specific Gravity - 2.10 to 2.40
- Solubility in water - Insoluble
- Bulk Density - Densified - 608 to 720 kg/m3
- Specific Surface Area
- Super Refractory Grade – 22-25 m2/g- Silicon Metal production
- Standard grade – 15-20 m2/g –Ferrosilicon production
- Dark colour – High carbon content
- Light colour – Low carbon content
- Particle size is almost 100 times finer than cement

# Micro Silica

| | BULK DENSITY kg / m3 | USAGE |
|---|---|---|
| UNDENSIFIED | 200- 300 | GROUTS,MORTARS,CONCRETE REPAIR SYSTEMS,PROTECTIVE COATINGG |
| DENSIFIED | 500-700 | PRECAST WORKS<br>READY-MIXED PLANTS (WET) |
| MICRO-PELLETISED | 600-800 | BLENDED CEMENT PRODUCTION |
| SLURRY | 1400 kg /m3 | ANY TYPE OF CONCRETE PRODUCTION |
| ADMIXTURE BLENDED | | TOGETHER WITH ACCELERATORS,PLASTICIZERS OR ANY SUCH COMBINATION |

### ❖ Micro Silica - Advantages

- Improves early strength
- Improves final strength
- Concrete is non segregating and non bleeding
- Well compacted and highly impermeable
- Highly reactive silica makes the concrete resistant to chemicals
- Can produce high performance concrete

## ❖ Chemical Admixtures

### ❖ Types of chemical Admixtures

- Plasticizers
- Superplasticizers
- Air Entrainers
- Waterproofing Admixtures
- Anti washout Admixtures for underwater concreting
- Shotcrete Admixtures
- Pumping Aids
- Light Weight Admixtures
- Corrosion Inhibiting Admixtures
- Viscosity Modifying Admixtures
- Expansive Agents
- Stabilizers/ Activators

### ❖ Plasticizers ( Water Reducers)

BS5075 Part 1, ASTM C494 Type A-E

A. Water reducing
B. Retarding
C. Accelerating
D. Water Reducing Retarding
E. Water Reducing Accelerating

❖ **Super plasticizers (High Range water Reducers)**

BS 5075 Part 3, ASTM C494 Type F-G

F. High Range Water Reducing

G. High Range Water Reducing Retarding

❖ **Air Entraining Agents**

BS 5075 Part 2, ASTM C260

- Equal sized micro air bubbles are entrained in concrete
- Increase the workability of concrete
- Concrete is safeguarded against freezing and thawing
- Reduce the strength
- Micro bubbles 10-500 micrometre
- Use the air meter to observe the air entrainment

❖ **Waterproofing Admixtures**

- Silicates,Oleates and Stearates
- Limitations for use (Grade of concrete matters)
- Difficult to check the effectiveness on site
- Block the pores and capillaries in the concrete
- Added to the concrete during batching

❖ **Anti washout admixtures (Underwater Concreting)**

- Help keep the concrete High viscous
- Work with law w/c
- Always use a tremie to place concrete under water
- Must be used with superplasticizer to reduce w/c.
- Preferably the cement content should be min 400kg/m3
- Sand content 45% or higher
- Cohesiveness can be increased with Silica Fume
- Entrain air and decrease strength

## ❖ Shotcrete Admixtures

ASTM C 1141

- Accelerate the setting time (Flash setting)
- Reduce the re-bounce
- Make the concrete non saggy enabling to spray thick layers
- Mortar spraying and Concrete spraying
- Limitation on aggregate size
- Wet and dry methods

# ❖ Waterproofing in Construction

Convenience for usage and the durability are basically the main aspects of a successful construction. The impact of leakage of water negatively contributes to these primary objectives.

- Durability Aspects
- Usability Aspects

## ❖ Durability aspects

- Protect the reinforcements from water
- Protect the reinforcements and cement matrix from chemicals such as chlorides, sulphates and other water soluble chemicals
- Protect other accessories such as electrical, mechanical, electronic and other sensitive items

## ❖ Usability Aspects

- Leaking bathrooms
- Leaking Roofs
- Leaking Basements
- Leaking Dams
- Waste of water/ money
- Leaking Reservoirs / swimming pools
- Leaking Tunnels
- Wetness in operation theaters
- Wetness in bank wallets
- Deteriorate internal finishes
- Bacterial Development
- Leaking in masonry structures
- Leaking in historical Architectural monuments

What is meant by waterproofing?

## Waterproofing = Watertight + Damp proof

Why concrete is not a waterproof material.

Consider how concrete is made,

| Cement | ✚ | Aggregate | ✚ | Water for hydration | ✚ | Water for workability |
|---|---|---|---|---|---|---|

Excess water gradually evaporates and leave the capillaries in the concrete

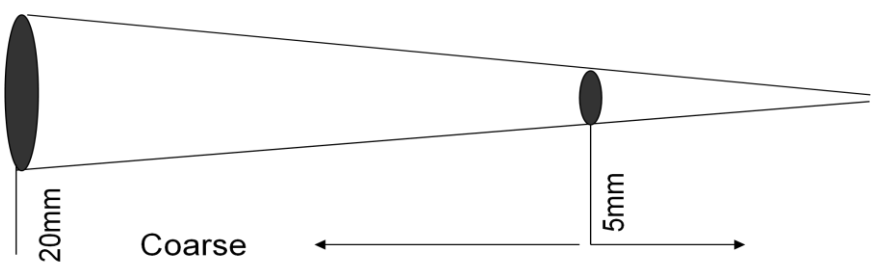
- ❖ Waterproof concrete for water retaining structures code BS 8007
  - Limit crack width
  - Incorporate crack control reinforcements

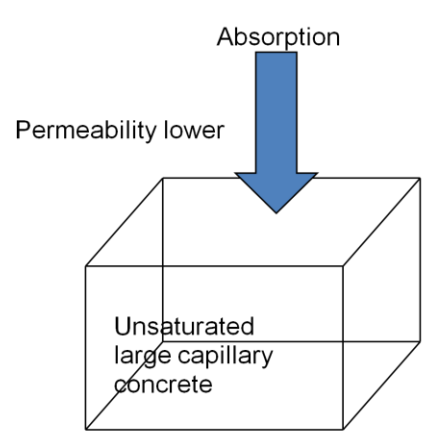
Or/and

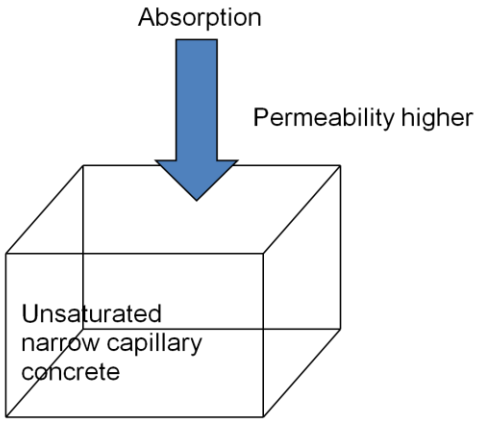
- ❖ Use Mineral Admixtures
  - Fly Ash
  - Silica Fume
  - GGBFS
  - Natural Pozzolans

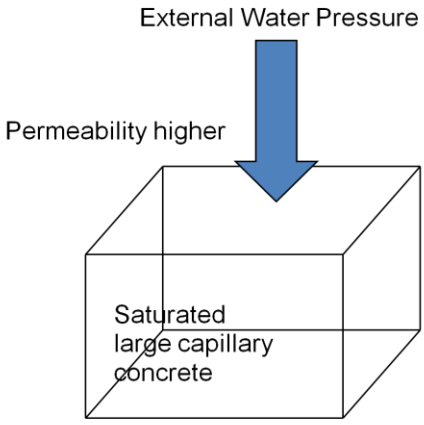
- ❖ Two main advantages
  - Densify the cement Matrix
  - Intensively reacts with Hydrated lime

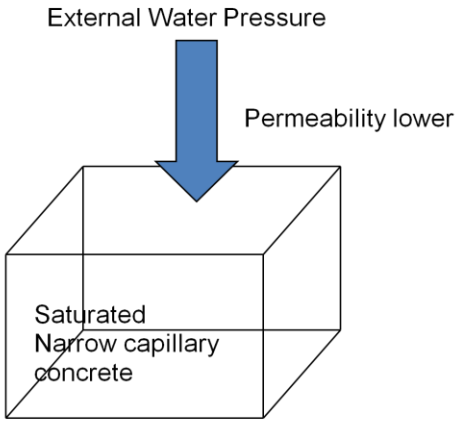
GAP GRADED AGGREGATE






It is realized that the concrete is not damp proof or vapor proof. But it is only watertight.

## ❖ Waterproofing

Permanent waterproofing basically classified in to,

- Integral waterproofing
- Surface waterproofing

### ❖ Integral Waterproofing

- Mineral Admixtures
- Hydrophobic agents
- Waterstops
- PU Injections
- Penetrating sealers

❖ **Surface waterproofing**
- Pre-formed Membranes
- Coatings
- Sealants
- Waterstops

❖ **Pre-formed Membrane (Bitumen, HDPE, PVC,etc)**
- Self adhesive membranes
- Torch-on membranes
- Non-adhesive membranes
- Loose laying membranes

❖ **Coatings Flexible/Rigid**

❖ Flexible coatings

- Polymer cement
- Polyurethanes
- SBR Latex
- Acrylic
- Bituminous
- Emulsions

❖ Rigid coatings

- Cementitious
- Epoxy

❖ Golden Rules

- Selection of Right Materials
- Correct Methodology
- Tailor made detailing
- Workmanship

## ❖ Repairs and restorations

❖ **Need repairs to**

- Concrete
- Masonry

## ❖ Nature of repairs

- Cracks
- Patch
- Filling
- Retrofitting
- Enhancements/ widening

## ❖ Crack Repair Considerations

- Reason for cracking
- Expected Expansion or movement
- Strength of the element
- Age of the structure
- Compatibility of repair material
- Bonding requirement
- Crack width and the pattern
- Wet/dry condition
- Repair materials
- Repair methodology
- Machinery requirement

## ❖ Reasons for cracking

- External impact on the structure
- Settlement
- Overload
- Corrosion of reinforcement
- Design faults
- Construction faults
- Inadequate curing
- Shrinkage
- Plastic settlement
- Alkali-silica reaction, etc.

## ❖ Crack Repairs of Masonry Structures

- Cementitious Non-shrink grout
- Cement Paste with expansion agents
- Cement Paste with Bonding Agents
- Bonding agents with high solid content
- Pump or pour in to saturated wet cavity
- Must fill the full section of the element
- Pump from bottom to top
- Use low pressure hand operated pumps

### ❖ Crack Repairs for concrete elements

- Polymer modified non-shrink grout for clear fractures
- Epoxy Injection Resin for fine-moderate cracks(dry)
- Low viscous epoxy resin for floor cracks
- High pressure injection pumps
- Seal between injection ports with Epoxy paste
- Inject from lower end to upper end
- Epoxy injection only on dry cracks

### ❖ Patch/ Honeycomb repair for concrete

- Bonding agents
- Anti-corrosive treatments for steel
- Non shrink cementitious grout – Trowellable or pumpable
- Non shrink polymer grout for overhead application
- Curing agents
- Initiate treatment on saturated substrate
- Build up the layers wet on wet with trowel
- Pump grout into cavity
- Pump grout into pre-packed aggregate cavity

### ❖ Retrofitting

- Engineers advise
- Carbon fiber mesh
- Epoxy Resin
- Steel plate
- Surface preparation of concrete elements
- Dry substrate

## ❖ Flooring

### ❖ Epoxy Floor – Features

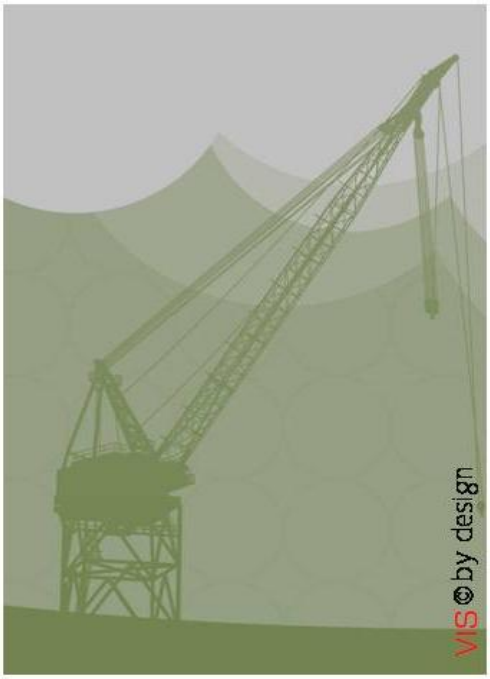
- Decorative
- Heavy duty
- Hygienic
- Chemical Resistant
- Abrasion Resistant
- Washable
- Completely leveled
- Seamless
- Repairable
- Non staining

❖ **Suggested Applications**

- Offices
- Showrooms
- Factories
- Warehouses
- Parking Areas
- Tennis courts
- Athletic tracks
- Operation theaters
- Hospitals
- Processing Areas

❖ **Floor hardeners**

These are cement based powders blended with finely ground mineral, metallic or extra heavy duty particles such as carborandum. Once sprinkled over the wet concrete floor, it is trowelled on to the concrete to make a monolithic abrasion resistant floor. They are highly resistant to wearing off caused due to continuous use of heavy traffic such as fork lifts etc. Metallic floors are ideal for dry wherehouses while the others suitable for factories, processing and packing areas or wet areas.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