COMPARATIVE STUDY - DRAWBACKS OF DIFFERENT WATERPROOFING CHEMICALS (ADMIXTURES, APP, BITUMEN, POLYMER MODIFIED BITUMEN, POLYURETHANE, STYRENE BUTADIENE, SILANE/SILOXANE- NANOTECHNOLOGY BASED, EPOXY, ACRYLIC, WATERPROOFING)-The below study outlines the inherent drawback different generation of waterproofing products suffer vis a vis CONSCHEM WAIEU

ADMIXTURE

- According to chapter 15 of the ACI (American Concrete Institute) 212 report secondary waterproofing admixtures (PRAN-permeability reducing Admixtures without Hydrostatic capacity)) should only be specified or use in situations where the concrete will not be exposed to hydrostatic pressure both now and in the future. In other words area that are not below sea level and where the water table are not susceptible to rising.

It is only sensible that we use secondary waterproofing admixtures, in a situation that we are sure that the water table will not rise both now and in the future. However, because it is difficult to make this kind of prediction with any level of accuracy, it may be wiser to follow the ACI guidelines and stick with the secondary admixtures in most instances.

Architects and structural engineers specifying for large scale projects, especially projects with basements will have to make the critical decisions on the choice of admixtures for the foundation, basements and other below grade area of their clients’ projects. When a wrong choice is made at this point, it may permanently hunt the project. Nothing is as frustrating as a leaking basement, paint peel off or dampness on a major project even before handing over to client. Usually this requires more effort and resources to fix and sometimes you may never get 100% result in fixing the leakages.

- Retarders should be used in proper amount. Access amount will cause indefinite setting time.
- Even admixture mixed concrete is unable to contain water incursion through joints, corners etc. making need for use of primary waterproofing obvious.

ATACTIC POLYPROPYLENE (APP)

- HYGIENIC PROBLEMS OF ATACTIC POLYPROPYLENE (Source: National Center for Biotechnology Information at the U.S. National Library of Medicine (NCBI/NLM).
- Simple Google search with the key words ‘roof torch fire’ will present you with enough articles on fires related to torch applied roofing
- Highly Skilled workmen required to ensure effective application on the surface due to seam, heat temperature, duration of heating etc.
- Modified Bitumen used as primer has its own set of drawbacks. If the membrane is not torched properly, it will result in de-lamination, slippage-blisters of felts, and accelerated aging
- Failure of just a few feet of seams will spell disaster for a roof that can allow the migration of infiltrated water. Irreversible damage to the roof system is likely to occur long before water is noticed entering the building.

BITUMEN
• Improper installation of flashing as a source of leaks on torch-applied modified bitumen roofs.
• Inadequate head laps and backwater laps are another modified bitumen installation problem that can allow moisture infiltration.
• With cold-applied modified bitumen, improper storage of materials can result in moisture infiltration built into the roofing system, and under-application of adhesive can result in poor lamination and roof leaks.
• BLOW-OFFS, TENTING, REDUCED WIND UPLIFT RESISTANCE, AND BILLOWING Wind uplift resistance can be reduced greatly if seams are not cured adequately on cold-applied mod bit systems. Seams made with cold adhesives do not have good integrity until the adhesive has cured. If the seams are exposed to wind and rain before they are properly cured, moisture can infiltrate the roof system or wind uplift can damage the roof membrane. If not adhered properly to the substrate, single-ply roofs are at risk for blow-off and billowing.
• POOR INSTALLATION AND UNSATISFACTORY WORKMANSHIP A faulty installation dramatically increases the likelihood of problems and reduces a roof system’s life expectancy. Problems with adhesion can result when the area isn’t cleaned, dried, and primed properly prior to installation.
• Torch-applied mod bit system performance can be compromised if crews do not relax the sheets prior to installation. Material preparation is important to a quality installation. Sheets installed that have not relaxed or are installed when ambient conditions such as temperature are not right can result in wrinkles, leaks, fish mouths, contraction of sheets, or blisters.
• Asphalt does not like being exposed to UV. Therefore, the surface of the installed system needs to be protected from these destructive rays.
• PUNCTURES AND THE ADDITION OF PENETRATIONS POST-INSTALLATION damage from foot traffic can be problematic.
• All roof systems’ performance is compromised when new equipment and penetrations are added to an existing roof, unless proper precautions are taken.
• SAFETY The installation of hot bituminous and torch-applied mod bit systems requires strict adherence to safety procedures. Overheating asphalt can result in burns, and fires in the kettle and on the roof. During installation, odors from cold-applied mod bit systems can cause discomfort and alleged illness among building occupants.
• Voids and holidays can be problematic in the application of torch-applied modified bitumen. If the membrane is not torched properly, it will result in de-lamination, slippage, and blisters. Moisture and air trapped in modified bitumen roofs can vaporize, causing a blister.

POLYMER MODIFIED BITUMEN
• Best suited for cooler climates
• Provide protective coating after curing time of 690 days.
• Cracks under weathering.
• Black in colour and therefore heat absorbent and not pleasing in appearance.

SILANE/SILOXANE (Silicon Derivatives - Part of nano tech)
• Can burn using carbon dioxide as an oxidize. A number of fatal industrial accidents produced by combustion and detonation of leaked silane in air have been reported. Diluted silane mixtures with inert gases such as nitrogen or argon are even more likely to ignite when leaked into open air.
• Silane is fairly toxic: the lethal concentration in air for rats (LC50) is 0.96% (9,600 ppm) over a 4-hour exposure. In addition, contact with eyes may form silicic acid with resultant irritation.
In regards to occupational exposure of silane to workers, the US National Institute for Occupational Safety and Health has set a recommended exposure limit of 5 ppm (7 mg/m$^3$) over an eight-hour time-weighted average.\textsuperscript{1} Environment Canada assessments concluded that cyclotetrasiloxane and cyclopentasiloxane — also known as D4 and D5 — are toxic, persistent, and have the potential to bioaccumulate in aquatic organisms \textsuperscript{1,ii}. Also, the European Union classifies D4 as an endocrine disruptor, based on evidence that it interferes with human hormone function \textsuperscript{iii}, and a possible reproductive toxicant that may impair human fertility \textsuperscript{iv}. In laboratory experiments, exposure to high doses of D5 has been shown to cause uterine tumours and harm to the reproductive and immune systems. D5 can also influence neurotransmitters in the nervous system \textsuperscript{v}. Structurally similar to D4 and D5, cyclohexasiloxane (or D6) is also persistent and has the potential to bioaccumulate. The coating of Silane/Siloxane is not effective if the mortar plaster is weak and voids between base surface and plaster surface.

**Limitations of Nanotechnology Based Water proofing compounds:**

- As in the case of APP application, highly skilled workmen required at all stages of application.
- These are generally not suitable for frozen or frosted surface and the sealer should not be applied below 500F, nor should the sealer be exposed to freezing conditions during the first 24 hours of drying.
- Water proofing materials should be used within 24 hours of mixing.
- These compounds should not be applied over previously sealed/painted surfaces.
- These should not be applied during windy conditions or when rain is expected within 2 hours.
- Should not be applied over concrete that has not reached 80% design strength and until completely dry.

**STYRENE BUTADIENE LATEX**

- Styrene Butadiene Latex has effect as carcinogenic, genotoxic and reproductive toxic and neuro toxic.
- It is also soil, water and air pollutant. [http://www.epa.gov/chemfact/styre-sd.txt](http://www.epa.gov/chemfact/styre-sd.txt)
- Besides SBR Latex are not suitable for masonry surface prone to heating, rubber being one of components.
- Non suitable for macropores.
- Presence of loose particles on the applied surface creates void.

**POLYURETHANE**

- Isocyanates are the raw materials that make up all polyurethane products. Health effects of isocyanate exposure include irritation of skin and mucous membranes, chest tightness, and difficult breathing. Isocyanates include compounds classified as potential human carcinogens and known to cause cancer in animals. The main effects of hazardous exposures are occupational asthma and other lung problems, as well as irritation of the eyes, nose, throat, and skin.
- Ozone-depleting methylene chloride and chlorofluorocarbons present in polyurethane contribute to indoor and outdoor air pollution.
- During the installation of spray polyurethane foam systems, recovering over a wet substrate can result in severe blistering and de-lamination. Can be be applied on completely dry surface.
- Adverse effect of ultraviolet rays and requires covering by materials resistant to sun rays.

**EPOXY**

- Humidity Solvent based Epoxy products do not bond well with humidity
• Faulty Resin/ Hardener mix. Ever seen the coating not cure properly? Did it remain sticky or soft long after the application was finished? This was caused by a faulty mix between the resin and the hardener: - Mixing incorrect or inaccurate proportions of the components - Not mixing the material properly or for a long enough time.

• When epoxy fumes are inhaled, they can affect the nose, throat, and lungs. Most symptoms from the inhalation of epoxy involve inflammation and therefore irritation of the nose, throat, and lungs. Repetitive and high amounts of exposure to these fumes can result in sensitization and asthma. When dust from partially cured epoxy is inhaled, the particles become trapped in the mucus lining of the respiratory system and can cause serious health problems.

• The chemical reaction that cures mixed epoxy is *exothermic*, or heat generating. If left to cure in a contained mass, such as in a mixing pot, it can generate enough heat to melt plastic, burn your skin or ignite surrounding combustible materials. The larger or thicker the epoxy mass, the more heat generated. A 100-gram mass of mixed epoxy can reach 400°F.

ACRYLATES

• It is not very effective over extremely porous masonry surfaces. Air bubbles preventing waterproofing film.
• Their limitations include the need to be recoated periodically.
• The difficulty of application at their low recommended spreading rates.
• If proper overlapping is not done there might be chances of ineffective coating due to low spread rate and faster setting of polymer cement.
• Not suitable for marcopores.
• Can be applied only when ambient temperature below 35 degree celsius.

• #1. All non Integral waterproofing compounds have serious defect that after shrinkage of cementitious surface after dehydration their bonding with the surface on which it was applied on become somewhat weaker and there remains chances of voids, pores, debinding etc.

• #2. PLEASE NOTE ALL THE COATING BASED WATERPROOFING HAS PROMINENT DRAWBACK THAT IF SOMETHING WRONG HAPPENS WITH THE COATING (e. g, reasons given under BITUMEN section) the waterproofing becomes useless.

• #3. Latex, Acrylic based waterproofing cannot prevent root formation through- Fungi,Algae,Moss etc. and therefore the applied surface becomes weak-porous after certain lapse of time , rendering waterproofing ineffective.

• #4. Cement mixed with water containing soluble salts when dried up, form crystals resulting in efflorescence and cementitious polymer, elastomer based waterproofing are ineffective to prevent pores formed because of water soluble salt crystals.

• #5. Crystalline waterproofing is effective in the sense that drawbacks of coating based waterproofing are removed and external minor damages to the plaster surfaces don’t have any effect on waterproofing protection.