

Application of Construction Chemicals in Building Construction

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Abstract: The main object of this paper is to no concrete without construction chemicals. They are used in concrete at the time of construction or during maintenance/ repairs to produce several desirable properties. Twenty years ago, construction chemicals were rarely adopted in India, but today there is a great awareness among practicing Engineers, contractors and public about the use of construction chemicals. To suit the demand, in India, number of companies are emerging in the field of construction chemicals. Plenty of such products are available in the market. But there are no specifications and standards about their usage. In the absence of these norms, the companies advertise their products as Hi-tech and Super stuff. The only literature available is the manufacturers' brochures. Therefore, the user finds it very difficult to choose a particular product. A comprehensive study about these chemicals was made in this work to evaluate their performance by conducting a series of laboratory tests. Several crores of rupees are being spent throughout the world on rehabilitation and restoration of structures. In traditional methods of repairs, the same problems may occur within a short span of time due to i) Inadequate bonding of new concrete to old concrete or new plaster to old plaster ii) Corrosion of reinforcement bars not being totally removed. Today, construction chemicals play a vital role in repairs. They provide a long-term solution in the rehabilitation of distressed members.

Keywords: construction chemicals, building construction.

1. Introduction

The topic of this project is Application of Construction Chemicals in Building Construction. 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 largescale 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 a better, faster, and more convenient way of life.

2. Relevance

Building construction requires strengthening. Construction chemicals have always been playing important roles in virtually all sorts of construction projects, be it industrial projects, residential building projects, commercial building projects and so on. These chemicals are often used in various elements of projects in order to achieve various important qualities such as workability, durability etc. Construction chemicals exist in many varieties from large number of manufacturers worldwide.

Construction chemicals are used by the construction and civil repair industry. These chemicals help enhance concrete strength and quality, provide watertightness and protect concrete structures from atmospheric degradation. Several manufacturers offer a wide range of products for applications in concrete modification, waterproofing, repair and rehabilitation of structures. Products like admixtures for concrete, sealants, grouts, concrete curing compounds, tile fixing adhesives, waterproofing chemicals, membranes, jointing compounds, crack repair and special application mortars are offered.

3. Literature Review

Waterproofing in building construction (Er. Shamanth Kumar M, 4th March 2020) The Modern waterproofing systems deal with sustainable architecture by a dual course of action on its application to the source. Various and specific coats with certain proportions of chemicals allow the process to multitask, with ease. The parallel effect of energy conservation occurs because of the use of materials involved in the process. This largely includes the coats on the external walls and floors, which cuts down the heat flow into the building thereby reducing the load on improving the indoor air quality and air conditioning of a space. Waterproofing systems can also be

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stated as “structural protection and rehabilitation’ or “renewable engineering”, because of its multi-action ability and importance. Waterproofing is not only a major part of the procedure of building construction but also hold the dignity in grading a site. (Grading here refers broadly to identification, control and improving the land for proper construction). Therefore, a waterproofing system is technically applicable not only to the building envelope as a whole, but also to the specific parts of a structure.

New Product Systems in Construction Chemicals (Milind Gokhale International Journal of Scientific & Engineering Research Volume 10, Issue 12, December-2019) The driving factors influencing the role of new product branding in B2B market for start-up organizations in construction chemical. Construction chemicals are playing a significant role than before to meet the demands of durability, high strength, sustainability and economy and of hi-tech infrastructures that are remodeling new modern structures today. The paper identifies the driving factors from numerous market research studies into new product development’s performance in construction chemical sector. The study defines three categories of these driving factors. The first driving factor operates at product level, which includes innovative approaches and how the organization invests in its R&D area. The second driving factor operates at operational level, which includes appropriate and effective launch process and targeting of right clients through proper channels. Third driving factor operates at business level, which emphasize on easy-to-use concept.

Construction chemicals providing strength to construction industry (Business-Standard M A Waheed 11th Jul 2014) The evolution and significance of construction chemicals in the building and infrastructure sector. Historical Evolution: Cement concrete and mortar became primary building materials in the 20th century, but initial ordinary Portland cement suffered from issues like shrinkage cracks and leakages. Chemical modifications addressed these weaknesses, leading to the development of construction chemicals. Development of Construction Chemicals Industry: With growing demand for robust structures in various conditions, further modifications to concrete were necessary. This led to the evolution of the construction chemicals industry, focused on enhancing concrete performance, workability, and durability in diverse environmental conditions. Lack of Integration in Indian Construction Practices: Post-independence, Indian construction practices didn't advance at the same pace as developed nations, resulting in slower adoption of construction chemicals. They were often considered only for distressed structures or exceptional requirements like high-strength bridges, instead of being integral to regular construction projects. Need for Updated Codes and Standards: To create safe and durable structures, there's a necessity to update outdated civil engineering codes, practices, and syllabi in engineering colleges. This should include new codes not just for civil engineering but also for construction chemicals, ensuring the right materials are used for construction.

Performance Assessment of Construction Chemical in Building Construction (Anil Kumar Gupta, Rahul Satbhैया,

06/06/2016) The ubiquitous use of construction chemicals and admixtures in modern concrete practices, emphasizing their importance in achieving desired properties during construction and maintenance. Two decades ago, their usage was minimal in India, but today, there's widespread awareness among engineers, contractors, and the public about their significance. The increased demand has led to the emergence of numerous companies specializing in construction chemicals in India. However, despite the abundance of products in the market, the absence of specifications and standards complicates the selection process for users. Manufacturer brochures serve as the primary source of information, making it challenging for users to make informed choices. To address this gap, the research conducted a comprehensive study evaluating the performance of various construction chemicals through a series of laboratory tests. It aimed to guide users in selecting the appropriate product among the multitude available. The paper emphasizes the crucial role of construction chemicals in the repair and rehabilitation of structures, noting that traditional repair methods often lead to recurring issues due to inadequate bonding or corrosion problems. Construction chemicals offer long-term solutions by restoring distressed structures to their original state within a short period. By conducting rigorous laboratory tests and providing guidance on product selection, the research aims to significantly benefit the civil engineering profession and society as a whole by facilitating informed choices and enhancing the effectiveness of construction chemicals in building and repairing structures

Global Construction Chemicals Growth Opportunities – (marketresearch.com/ Published by: Frost & Sullivan, Mar 09, 2023) The construction chemicals, encompassing substances enhancing construction material performance, particularly in concrete and mortar admixtures, waterproofing agents, tile adhesives, grout, and concrete repair materials. The market presents growth prospects for manufacturers, suppliers, distributors, and consumers, driven by increased construction activities worldwide. Global expansion in the construction chemicals market aligns with the growth of the construction industry. Factors like heightened construction endeavors, quality enhancement, and the evolving needs of consumers propel this expansion. Rapid urbanization and industrialization in regions like India, Southeast Asia, and Latin America contribute significantly to the increased demand for both residential and non-residential construction. The significance of material type in constructing tall buildings is emphasized, underscoring the role of construction chemicals in fortifying structures for durability and longevity. Increased awareness regarding the benefits of waterproofing chemicals is driving their usage, especially in larger projects. While concrete admixtures are well-established in developed regions like North America, there's a growing penetration in Latin America due to lower usage rates and escalating construction activities. Ready-mix concrete (RMC) usage, prevalent in the United States, plays a significant role, with about 75% of cement consumption being in RMC form.

Construction Chemicals Market Research Report Information By Type Admixtures, Flooring, Waterproofing,

Repair & Rehabilitation, and Others. (Priya Nagrale, November 2023) Construction Chemicals market's growth, primarily driven by key players investing substantially in research and development (R&D) to expand their product lines. These initiatives, including new product launches, collaborations, mergers, acquisitions, and increased investments, aim to enhance market presence globally. Competitors in this industry face an increasingly competitive environment and are striving to offer cost-effective products to sustain and grow. To benefit customers and expand their market share, many companies are adopting the strategy of local manufacturing, aiming to reduce operating costs. Several major players, including BASF SE, Ashland Inc., Pidilite Industries Ltd, and Sika AG, are at the forefront of driving market demand through extensive R&D investments. For instance, BASF operates through various segments, offering a wide range of chemical products across diverse industries. Ashland specializes in specialty chemical solutions, such as natural, synthetic, and semisynthetic polymers, adhesives, and resin-based products in the construction sector. The emphasis remains on innovation, expanded product offerings, and cost-effective strategies, highlighting the importance of R&D and strategic initiatives in propelling the Construction Chemicals market's growth and competitiveness.

4. Research Gap

- 1) Improper Customer Services: The industry is not emphasizing the marketing activities. As a result, there is a lack of technical personnels in the marketing department of the organizations. The repercussion results in improper customer service.
- 2) Costly Products: The use of the construction chemicals increases the cost to the developers by two to five percent. Also, the standard products are costlier than that of the substandard products.
- 3) Low Skilled Labour: The construction chemical industry is explored less by the chemical industry technicians. Also, the industry is at the nascent emerging stage. Therefore, it is difficult to get skilled labour for the industry processes.
- 4) Low Awareness: Around eighty five percent of the construction industry personnels are not aware of the concept of construction chemicals. They are not aware of the productivity improvement and value addition for the construction works if the chemicals are used at proper time and in proper manner.
- 5) Lack of Technical Guidance: The result of the application of construction chemicals depends mainly on the way or manner in which the chemical has been used. The application of the chemicals requires excellent technical guidance to get the best results out of such costly products. So, they require technical guidance to develop the skills required for the application.
- 6) Unskilled End Users: A large chunk of construction industry labours is unskilled or low skilled. Whereas the construction chemical application requires adept knowledge to get the best results. Hence many a times the customers are not satisfied with the results of the construction chemical.

- 7) Lack of Research & Development: The Research & Development investments of the Indian companies is less than that of the MNCs. The construction chemicals are used only for a specific purpose either to add value or to improve productivity of the existing product. So, a continuous R & D effort is necessary for the growth of the industry.

5. Applying PU Acrylic Hybrid Waterproofing Membrane Over a Damaged and Leaking Rooftop

Introduction: Roof waterproofing is essential for maintaining the integrity of any building structure. In this case study, we will examine the roof waterproofing project of a residential building located in a region with a tropical climate, characterized by heavy rainfall and high humidity.

The Problem: Old structure (Over 20 years old) located in Mumbai. The roof's surface was made up of brick bat coba with China mosaic tiles. Many of the China mosaic tiles surfaces had become loose enabling water to creep underneath between the tiles and the cement. The customer was looking for a solution without needing to replace the entire roof. The client was facing a persistent issue of leakage from their roof, causing significant damage to their property. The challenge was to find a solution that would effectively address the leakage problem and prevent any further damage

6. Methodology

Problem Identification: The building had several issues due to water leakage and seepages: Water stains and leakage on the ceilings of the top floor Mold and mildew growth Deterioration of the roof slab Complaints from regarding indoor air quality and comfort Lack of thermal Comfort

Objectives: Eliminate water leaks and seepage. Enhance the durability and lifespan of the roof. Improve indoor air quality by preventing mold growth. Reduces surfaces temp of the roof, which will enhance thermal comfort. Minimize disruption to the building's operations during the waterproofing process. Conduct roof waterproofing by without disturbing entire roof structure.

Selection of Waterproofing System: Based on the assessment, a liquid-applied membrane system was chosen due to its seamless application and flexibility. The system selected was a polyurethane-based coating known for its durability and UV resistance. Hybrid roof coatings based on acrylic and polyurethane. Both acrylic and polyurethane are well. known roof coating materials. PU Acrylic is the most cost-effective coating material, good for most climates and ideal for short-term sealing needs (i.e. ten-year protection). It is generally highly reflective, UV resistant, and easy to work with, but it's not the ideal material to seal your roof against ponding water. Polyurethane, on the other hand, is a more durable coating material than acrylic, and more resistant to ponding water. However, it is not as cost-effective as acrylic, and it can also have a stronger odor. When these two materials combine into a hybrid roof coating, their advantages and excellent features also combine, in a balanced and efficient way! Hybrid roof coatings based on acrylic and polyurethane show increased tensile

strength, durability and high performance in extreme weather conditions, while they are easy to apply, odor less and cost-effective.

Surface Preparation: Proper surface preparation is critical for the success of any waterproofing project: Cleaning the roof surface to remove debris, dirt, and existing loose materials. Repairing cracks and damaged areas with suitable patching material. Priming the surface to ensure better adhesion of the waterproofing membrane.



Fig. 1. Cracks noticed and wider from 0.50 mm to 3 mm on terrace roof



Fig. 2. China mosaic surface is found to be de bonded and Cracks on drip mould



Fig. 3.

Cleaned the surface with air blower and removed dust & dirt. Cut all visible hairline cracked more than 0.50mm to 5mm width in "V" shape with mechanical cutter Fill cracked with PU sealant with suitable gun and smoothed with a putty knife or trowel. Allowed sealant to cured a minimum (72 Hrs.) 3 days.

Checked the existing roof surface with nylon hammer and removed the existing unsound, debonded screed, surface defects, etc. Broken and removed the hollow sound screed and plaster surface with mechanical cutter. Cleaned the surface and applied a bond coat of SBR latex mix in the ratio of 1:1 (SBR latex 1: Cement 1) by volume. Mixed SBR latex 10% by weight of cement in (M20) concrete in ratio of 1:1.5:3 i.e. Levelled the

repair mortar and finished with a trowel. Moist wet curing done for 7 days.



Fig. 4.

Application of Waterproofing Membrane: The liquid-applied polyurethane membrane was applied in multiple coats: A base coat to establish a strong bond with the primed surface. Intermediate coats to build up the membrane thickness. A final topcoat with UV-resistant properties to protect against solar radiation. Mix the coating thoroughly to ensure uniformity. Apply the PU hybrid acrylic coating using a brush, roller, or spray equipment. Apply in multiple coats if necessary, allowing each coat to dry before applying the next. This ensures the required thickness and performance are achieved. Ensure consistent coverage and avoid pooling or uneven application.



Fig. 5.



Fig. 6.

Applied a coat of Acrylic hybrid waterproofing membrane (diluted with water in the ratio 2:1) self-priming coat at the rate 8–10 sq.mt./litre/coat. The substrate MUST be in SSD condition for application of primer.

Applied 1st coat of Acrylic hybrid waterproofing membrane without dilution spreading at the rate of 2.0 / litre / Sq.mt / Coat until all surface is covered.



Fig. 7.



Fig. 8.

Allowed the first coat to dry for 4-6 hours before applying the 2nd coat. Applied 2nd coat with using 45 GSM Fiber glass mesh.



Fig. 9.

Applied the third coat of acrylic hybrid waterproofing membrane at an application direction that is perpendicular to that of the second coat with same application coverage rate. Checked to see no void surface is left untreated/uncoated. Made sure glass fibre mesh is completely embedded.

Curing: Allow the coating to cure completely. Curing times

can vary depending on the product and environmental conditions (temperature, humidity). Follow manufacturer's guidelines for optimal curing times and conditions.



Fig. 10.

Quality Control and Testing: Post-application inspections included: Visual inspection for uniformity and coverage. Adhesion tests to ensure the membrane was securely bonded. Water ponding tests to verify the membrane's waterproofing performance.



Fig. 11.



Fig. 12.

7. Result

Performance: The building remained leak-free during subsequent heavy rains. No signs of water infiltration were observed during water ponding inspections.

Tenant Satisfaction: Positive feedback from tenants regarding the thermal comfort levels inside their rooms.

Cost and Time Efficiency: The project was completed within the allocated budget and timeframe. Minimal disruption to the building's operations, with most work carried out during off-peak hours.

8. Conclusion

The successful waterproofing of Arjun Co-operative Housing Society Ltd. roof demonstrates the importance of a systematic approach to roof maintenance. The project highlights the effectiveness of liquid-applied polyurethane membranes in providing long-term protection against water infiltration. Regular maintenance and inspections are recommended to ensure the longevity of the waterproofing system.

At present there are about 100 types of construction chemicals available in the market and the range continues to expand as there is constant spree for quality enhancement. The construction chemicals are basically inorganic or organic materials or minerals, which when added to the concrete admixture enhance the life of concrete imparting them special properties as well result in the delay in the initiation of corrosion of steel rebar. There are many types of construction chemicals used in binders, waterproofing and repair of structures. They are used as concrete curing compounds, polymer bonding agents, mould releasing agents, form release agents, protective and decorative coatings, concrete floor hardeners, non-shrink high strength grout and many more. Construction chemicals are used by the construction and civil repair industry. These chemicals help enhance concrete strength and quality, provide watertightness and protect concrete structures from atmospheric degradation. The future of construction chemicals is promising, as more research and development are being conducted to explore new materials,

processes, and technologies that can offer better solutions for different needs and challenges. The future of construction chemicals is also dependent on the collaboration and integration of different sectors, such as waste management, biotechnology, nanotechnology, or information technology, which can provide new insights and resources for innovation.

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