

Application of Spray Polyurea in Architecture

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Abstract

SPUA is a highly reactive and non-polluting spray technology that developed in recent 20 years. The outstanding physical and chemical properties of this technology, process performance and environmental performance fully demonstrated its unparalleled superior performance than the traditional protection technology. Polyurea elastomer spray is widely used in high-speed railway, tunnels, water conservancy projects, wastewater treatment ponds, high-end architectural roofs and other fields have been rapid development in recent years. Application results show that spray polyurea waterproof material has excellent physical properties and construction performance, obviously, that is currently the world's most advanced waterproofing construction technology.

Keywords

SPUA, Spray, Construction, Waterproof.

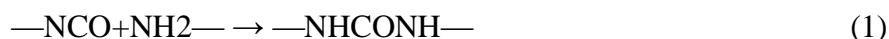
1. Introduction

The waterproofing of highways, railways, tunnels, industrial buildings and other waterproofing projects is increasing day by day with the rapid economic development in China [1]. Various types of waterproofing materials have also made great strides. However, compared with the advanced countries, the water-proof materials in our country are far from meeting the needs of China's economic construction in terms of product yield, quality and variety, as well as large gaps in supporting materials and construction technologies [2]. From the development trend of view, environmental protection, high performance, multi-functional, serialization and mechanization is the future direction of waterproof material development.

Spray Polyurea Elastomer Spray (Spray Polyurea Elastomer referred to as SPUA) technology is a foreign country since the nineties since the 1990s, following the high solids paint, water-based paint, radiation-cured coatings, powder coatings and other low-pollution coating technology, to adapt to environmental protection Demand and development of a new solvent-free, non-polluting green construction technology, corrosion, water, wear-resistant engineering applications such as a vast scene [3].

2. Polyurea chemistry

Polyurea is a polymeric material with urea linkages (-NHCONH-) formed by the reaction of terminal polyisocyanates (-NCO) with terminal polyamines (including resins and chain extenders) [4].



It requires no catalyst and does not require heating to react quickly. Spray polyurea (SPUA) to be heated to adjust the viscosity for easy uniform spray into the film. The cured polymer chain contains carbon-carbon bonds (-C-C-), ether bonds (-O-), urea bonds (-NHCONH-), ester bonds (-COO-), urethane bonds (-NHCOO-) and many more [5].

3. Polyurea history

Germany and the United States are the birthplace of spraying elastomer technology, the first to develop polyurethane coating and polyurethane elastomer technology is Bayer, BASF, Futura and Uniroyal and other companies. In the mid-1980s, the Texaco Company of the United States pioneered

the successful application of the sprayed polyelastoelastomer technology under the leadership of the chemist Dudley J. • Primeaux, and first published a research paper in 1989, causing a sensation. In 1991 the technology put into commercial use in North America, immediately showed its excellent overall performance, welcomed by users. Due to the difficulty of developing spray-polymerized elastomer formulations and processes, countries such as Australia and Southeast Asia have basically taken the approach of either overall import or joint venture with the United States.

Subsequently, the Jiangsu Provincial Institute of Chemical Technology, Yantai Walt, Hunan Xiangjiang, Guangzhou Xiupai, and other companies have devoted into the research. The United States SPI company, the United States New Zealand, South Korea, a mountain, the United States Paula, the Central Huanju polymerization, the United States joint coatings, the United States Shun Association, also one after another in the domestic sales service. At the same time, Huntslnan, Bayer, Germany BASF, Dow and other chemical giants in the United States also set up agents in China. The market for China's garment-wear shows a flourishing and thriving situation.

4. Polyurea technology advantage

4.1 Environmental performance

SPUA is a 100% solid, solvent-free, volatile organic-free, non-toxic, non-polluting green spray technology.

4.2 Physical and chemical properties

It has excellent resistance to water permeability, the overall seamless, dense tissue, tough, strong adhesion, the real "skin" waterproof. Polyurea can be used to meet the water surface water can also be used to waterproof the back surface. Polyurea elastomer coating can be long-term use at $-45\text{ }^{\circ}\text{C} \sim 120\text{ }^{\circ}\text{C}$, heat resistance up to $160\text{ }^{\circ}\text{C}$ (can withstand $160\text{ }^{\circ}\text{C}$ short-term thermal shock). Aromatic polyureas yellow under ultraviolet light. But no powdering and cracking, it can be used for a long time, resistant to freezing and thawing, thermal shock and snow storm alternating snow and ice impact. Polyurea has remarkable properties such as tensile strength, tear strength, impact strength, cohesion, elongation, abrasion resistance, puncture resistance, crush resistance, The protection of concrete cracking and reinforcement of the lost concrete structure. Good anti-corrosion function. Polyurea is resistant to the long-term immersion of most corrosive medium acids, bases, salts, seawater, chloride ions and the like [6].

4.3 Process performance

Polyurea high reactivity, fast curing, vertical, top and any surface can be continuous spraying does not sag. Polyurea elastomer without catalyst, 5 to 20 seconds gel, 10 minutes to reach the pedestrian strength, continuous spraying, a construction of unlimited thickness, short construction cycle, high efficiency. Nodes detail construction more convenient, do not need special fiber reinforced layer. Polyurea elastomer on metal, non-metallic substrates have strong adhesion, such as steel, aluminum, reinforced concrete, wood, fiberglass, polyurethane foam. Polyurea elastomer bond strength of concrete $\geq 5\text{MPa}$ (exceeding the bond strength between concrete).

Polyurea elastomer is less sensitive to temperature and humidity, and less affected by ambient temperature and humidity during construction. It should be applied on wet base with special primer. Polyurea elastomer spray equipment using complete sets of equipment, high production efficiency. With Graco-Gusmer's H-35 PRO, up to 2000 sq. Coating surface is smooth, continuous seamless. Adjust the process parameters, but also can be "ma face" -like surface, but also the surface of sand, increasing and asphalt concrete surface adhesion [7]. Polyurea elastomer can be added according to the requirements of various pigments, fillers made of different colors and functions of the coating, with excellent surface decoration.

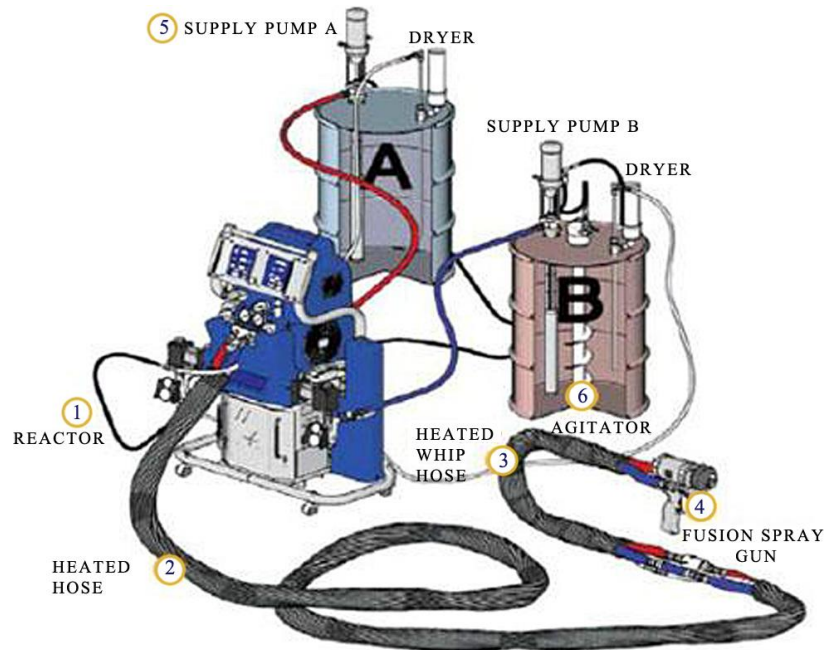


Fig. 1 Graco-Gusmer's H-35 PRO

Polyurea bond strength of concrete up to 5MPa, far greater than the peel strength of concrete (about 2.5MPa or so), so the cracking of the concrete substrate, the coating is stretched only in the concrete near the crack local peeling, thus avoiding the "original Bit stretch "; while other parts are still firmly bonded, is the real " skin "waterproof.

EPDM rubber and polymer modified bitumen membrane and other complex processes, low efficiency, greatly affected by human factors; polyurethane coating curing slow, long construction cycle; polyurea elastomer 1 minute surface dry, 10 minutes hard work , Fast curing, continuous thick coating, construction speed, high efficiency; can be formed in the complex profile, the coating continuous seamless. Polyurea does not require fiber reinforcement during detailed construction. It is good at sealing joints and construction joints. Polyurea with a dedicated primer can be constructed in the wet base, so the best polyurea technology.

4.4 Cost

In comparing the cost of the project, to compare the material cost under the same protective performance conditions, to compare the advantages of protective performance, the length of the useful life, the level of cost of life cycle and energy saving, environmental protection and social benefits, not only compare the material price High and low. It is debatable whether the win or lose at one cost only.

In terms of one-time costs, self-adhesive waterproofing membrane and polymer modified bitumen membrane slightly lower, EVA waterproofing sheet and polyurethane center, EPDM waterproofing membrane and polyurea slightly higher. In terms of useful life, polyurea longer service life, the other a variety of materials is low. If the average annual cost is calculated, the polyurea is lower and the other materials are higher. Construction and infrastructure repairs, repairs or refurbishments due to waterproof faults during the operation period will not only result in huge maintenance costs, but also cause huge indirect losses. Therefore, the selection of one-time cost is slightly higher, but superior performance, reliability and maintainability, long service life, low cost of life cycle, low average annual cost of polyurea elastomeric coating, slightly lower than the one-time cost of selection, but the use of Short life expectancy, high cost of life cycle, the average annual cost of other high waterproof protective material more economical.

5. Polyurea construction

Polyurea is a new type of waterproof coating, waterproofing in the construction of a wide range of applications. ① two-component spray polyurea coated with a special spraying machine on the base surface, the reaction speed, a few seconds to tens of seconds quickly gel, a few minutes that table dry. Fast curing is one of its salient advantages, but the high-level processing requirements. Due to the fast curing of the coating, the wetting time to the base layer is short, so the adhesive force of the coating to the base layer is greatly influenced by the base conditions, and the base layer is required to be strong, firm and smooth. The spraying surface is a continuous plane or a continuous curved surface. After the grass-roots moisture content, should be selected appropriate primer coating of grass-roots concrete. ② single-component polyurea machine without construction, can be used directly with manual roller coating and brushing. One-component polyurea curing relative to the two-component polyurea slow, surface dry time of about 2 ~ 4 h, curing time required 12 ~ 24 h. Due to the slow curing, so it infiltrated the base longer, the better adhesion to the grassroots. ③ In the actual construction operation, two-component spray polyurea and one-component coating polyurea can be used as high-grade waterproofing projects with long service life requirements, and can complement each other. For vertical facades, two-component spray polyurea and one-component polyurea non-sagging type can be used. For the horizontal plane, two-component polyurea and one-component polyurea construction, according to the size of the area and staff to determine the efficiency, and then make a choice. A Greco-Gusmer H20 / 35 sprayer normally requires 3 or 4 people to work together. One person is responsible for the spray gun, one or two people are in charge of the pipeline, and one person is in charge of the machine. It can spray 800-1 600 m² per day. One-component urea can be poured directly to the ground with a scraper with a positioning height can be flattened, it has a self-leveling properties, four people an average daily can be coated 1 000 ~ 2 000 m² plane area. For special areas, such as the details (such as the negative angle, root canal, etc.) and two-component spray from the drum needs to be repaired, with one-component polyurea to repair very convenient.

6. Conclusion

SPUA is the coveted waterproofing material for the construction industry with excellent water resistance, seamless, good adhesion, environmental friendliness, long service life and high cost performance. The material has been widely used in high-speed railway, Olympic venues, roofing, pool, subway, tunnels and other fields. The use of SPUA technology is the best choice for large-scale waterproofing projects in high-speed railways, tunnels and other countries because it requires only one investment and does not require maintenance during using.

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