Deep Seal

Environmentally Safe

BENEFITS COMBATING H2S / ACID DETERIORATION OF CONCRETE

No portland cement concrete installation is 100% resistant to attack by acids. In damp conditions, for instance, there are numerous fumes in the atmosphere which form acids that attack concrete by dissolving and removing a part of the hydrated cement paste, leaving a softer, weaker mass. This form of attack is encountered in various industrial conditions, such as chimneys, and in some agricultural conditions, such as floors of dairies. In practice, the degree of attack increases as acidity increases. Attack occurs at pH values of below 6.5, with a pH of less than 4.5 leading to a severe attack. The rate of attack also depends on the ability of hydrogen ions to be diffused throughout the cement gel or paste (C-S-H) via water or free moisture, dissolving or leaching out $Ca(OH)_2$ (calcium hydroxide) as it does so.

Subsequently, water treatment plants, sewer lines, manholes and appurtenances constructed of portland cement concrete have an extremely unique problem involving acid deterioration. Although normally alkaline in nature, domestic sewage causes acid deterioration of portland cement concrete especially at fairly high temperatures when sulphur compounds in sewage are reduced by anaerobic bacteria to H2S (hydrogen sulphide). Hydrogen sulphide (H2S) is sometimes found in some mineral waters. However, in sewer systems its presence is due mainly to the fact that it is produced in the decomposition of waste matter containing sulphur, such as excrement, etc. Hydrogen sulphide (H2S) is not a destructive agent in itself, but is carried through gases emitted by it becoming dissolved in moisture films on the exposed surface of nearby concrete where it undergoes oxidation by anaerobic bacteria, finally producing weak sulphuric acid which does progressively attack concrete, deteriorating its integrity to some degree.

Portland cement concrete is the most widely used construction material in our wastewater collection and treatment systems. When hydrogen sulphide (H2S) generation in wastewater is present, significant corrosion can occur due to hydrogen sulphide (H2S) gases to concrete above the wastewater's surface. The construction of regional collection and treatment systems has greatly increased wastewater travel time in collection systems, and which generally results in more hydrogen sulphide (H2S) gas generation. Hydrogen sulphide (H2S) is noted for its toxicity, as well as its ability to corrode many materials used in sewer and treatment plant construction, particularly concrete. Most treatment plant operator agencies are particularly sensitive to the nuisances created by the release of hydrogen sulphide (H2S) odors, but are very often unaware of the significant corrosion occurring to their concrete facilities until major damages suddenly become obvious.

Agencies have utilized several different types of coating systems over the years to protect concrete, to little or no avail. In the mid 1920's the use of vitrified clay liner plates in the construction of large poured-in-place sewers and inlet facilities proved unsuccessful. By mid 1960 many epoxy coating systems were being tried. Inspections have documented coating failures wherever exposure to significant sulphuric acid attack occurs. Very often any application flaws or coating failures go unnoticed for several years. Most agencies today are specifying, and have been for several years, the use of pvc liners that are formed in place with the concrete for new construction. Failures that have occurred with this system have generally involved seams in the pvc sheeting. A drawback of this lining system for rehabilitation work is the fact that the material is not bonded to the concrete but just attached at periodic locations where it is mechanically anchored to the concrete.

However today, due to continuing progress in concrete enhancement technology, there is available a product that will eliminate, or at least significantly retard, hydrogen sulphide (H2S) precipitated deterioration of concrete. It is not a coating, but instead is a penetrating solution that penetrates concrete, then becomes an integral part of the concrete itself. This product is DEEP SEAL**.** When **DEEP SEAL** is applied to concrete, **DEEP SEAL** immediately penetrates past its surface to permeate its matrix. As it does so, a portion of this unique solution becomes chemically absorbed by the cement gel or paste (C-S-H), becoming a residual part of this paste component, causing it to immediately become significantly more acid and chemical resistant. As the **DEEP SEAL**, while still in solution, permeates into the concretes interior, it begins contacting end reacting with free alkali (not affecting bound alkali) which is always present in portland cement concrete installations. As **DEEP SEAL** contacts free alkali, **DEEP SEAL** immediately transforms from an almost nil solids solution to a 100% solids insoluble mass deep inside the concretes interior occupying its accessible previously void pore spaces. This chemical transformation prolifically produces a colloidal gel, not generating heat or internal pressure, instantly providing increased density and additional bonding strength to the concrete.

This **DEEP SEAL** produced colloidal gel mass is made up of distinct spherically-shaped particles containing microscopic spine-shaped pore networks containing pore sizes smaller than a molecule of free water / moisture allowing the treated concrete to breathe as it needs to, but does not allow water or free moisture passage, except in greatly-diminished volume vapor form. Water / free moisture (including acids), present in concrete prior to a treatment, becomes chemically tied up in, and even participates in the formation of the **DEEP SEAL** produced colloidal gel mass rendering, these liquids harmless to the concrete. **DEEP SEAL** permeates to concretes interior. As a result, its cement paste is rendered significantly more acid resistant, plus a colloidal gel barrier is created just beneath the surface porosity, where most of the concretes free alkali normally lays, preventing acid-producing agents entry into the concretes interior from this treated surface.

The use of **DEEP SEAL** is recommended for use as a protectant in the preservation of concrete subjected to exposure or potential exposure to hydrogen sulphide gas (or other acid-producing agents). When **DEEP SEAL** is utilized in new construction, **DEEP SEAL** would serve as primary concrete protectant or back-up protectant should the coating / liner of choice eventually fail. This same concept would apply when rehabilitation plans call for the use of sacrificial cementitious material liners. However, many rehabilitation projects do not allow enough down time for conventional concrete surface repairs using cementitious materials followed by the installation of the liners, in which case **DEEP SEAL** would be ideal as a protectant, since it can be applied very quickly, as an acid-resistant waterproofer and surface bond enhancement for the sacrificial cementitious material liner, also later applied to the sacrificial concrete liner itself to

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