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TERMITE AND RODENT RESISTANCE OF PLASTIC PIPES

Plastics being organic in nature are susceptible to attack by biological agents. These agents may be broadly classified into two groups. One group consists of macrobiological agents, such as, rodents and insects where the attack is physical in nature, i.e., by growing or boring. This type of degradation is not at the molecular level but at the material structure level. The other group consists of microbiological agents, such as, fungi, bacteria and yeasts which can deteriorate plastics by deriving their nutrients from plasticizers and other additives which can be molecularly altered by micro organisms.

Although pure plastics are, in general, resistant to chemical alteration by bacterial and fungal attack, plastics are seldom used in their pure form. These are usually compouneded with plasticizers, fillers, pigments, processing aids and other additives which may be attacked by microbial agents. Of these, the plasticizer is the major contributor to fungal susceptibility.

Plasticized PVC products are reported to have been attacked by micro-organisms leading to changes in physical and chemical properties and surface discolouration. There are, however, no reports of microbial attack on unplasticized PVC products. This has resulted into the incorporation of antimicrobial agents in the plastic products to prevent degradation. The widely used anti-microbial agents are di and tri bromosalicylanilide, tri butyl tin oxide, N—(tri chloro methyl thio) phthalimide, N—(tri chloro methyl thio) tetra hydro phthalimide, do decyl dimethyl benzyl ammonium naphthenate and oxybisphenoxarsine in epoxidized soyabean oil.

Polymers Containing hexachlorophene and related bis chlorophenol compounds have been termed as antibacterial plastics. Hexachlorophene acts as a bacteriostat in a polymer and diffuses to the polymer surface at a rate high enough to maintain a level that will inhibit this growth of bacteria. This concept has been applied in poly olefins, vinyls, acrylics, ABS, and impact styrene to markedly reduce the cross contamination problems prevalent in hospitals.

Very little information is available in literature on attack of macro organisms on plastics, particularly plastic pipes. The important macrobiological agents are rodents and termites. This digest describes the results obtained at this Institute on termite and rodent resistance of plastic pipes. Three types of plastic pipes and fittings are being commercially produced in the country at present. These are low density polythene (LDPE) pipes, high density polythene (HDPE) pipes and unplasticized poly vinyl chloride (PVC) pipes. Of these, the unplasticized PVC piping systems are widely recognized for water supply in buildings.

Termite Resistance

Termites are well known for their capacity to damage and destroy wood and wood products. They can also damage non-cellulosic materials like leather and plastics, and have been reported to have attacked neoprene synthetic rubbers, phenol formaldehyde and Urea formaldelyde resins used as glues in plywood, polyethylene films, PVC coated underground cables, etc.

Termites mainly occur in the tropics and sub-tropics. There are about 2000 species of termites in the world. In India, nearly 200 species are known to occur. They can be broadly grouped into two categories viz., (a) wood dwelling termites which do not maintain any soil connection, and (b) ground-dwelling or subterranean termites which always maintain connection with soil for their moisture requirements. It is the latter type which is supposed to be hostile to plastic products mainly. All the three types of plastic pipes were subjected to

termite exposure in graveyards and termite mounds in the field and to termite colony in the laboratory.

Graveyard Exposure

Pipe samples were buried in soil in heavily termite-infested areas in the graveyard under two different conditions, (i) under shaded tree, and, (ii) under thatched roof at different exposure sites in the country, namely, Dehradun, Chala Budy, and Jodhpur for a period of 8 years, 3 years and 1½ years respectively. No damage of pipe material was noticed at any site.

Termite Mound Exposure

All the three types of pipe samples were exposed in the termite mound at Dehradun. They were taken out periodically and inspected. No damage was noticed in any of the three types of pipe materials after 8 years of continuous exposure in the termite mound.

Laboratory Exposure

Three types of pipe samples were exposed to termite colonies in the laboratory. the termite chosen was micro cerotermes beesoni, a virluent type of termite widely found in India. LDPE samples were found to possess enormous nibbling marks on the surface of pipe and also a hole in one sample at one place. In HDPE nibbling marks were few and there was no puncture whereas in case of PVC no damage of any kind was noticed. It could, therefore, be concluded that LDPE and HDPE pipes are attacked by termites whereas PVC pipes are resistant to termite attack. In graveyards and mounds the termites easily find food from several sources and thus by-pass and ignore plastic pipes.

Protection against termite attack

Since LDPE and HDPE pipes are not resistant to termite attack, they should not be laid in heavily termite infested areas. PVC pipes are resistant to termite attack as seen from the field and laboratory exposures described above. However, in order to ensure maximum safety it is recommended that plastic pipes should be laid underground avoiding termite infested areas as far as possible. However, when a pipeline has to pass through such areas, following treatments are recommended :

Mound Treatment

Termite mounds coming in the way should be destroyed by Insecticides in the form of water suspension or emulsion poured into the mounds at several places after breaking open the earthen structure and making holes with crowbars. The quantity to be used will depend on the size of the mound. For a mound volume of about one cu. m. four litres of emulsion in water of any one of the following chemicals may be used : (a) 5% DDT, (b) 0.5% BHC, (c) 0.25% dieldrin, and (d) 0.25% aldrin.

Soil Treatment

For soil treatment water emulsion of any one of the following chemicals may be used : (a) dield in 0.5%, (b) aldrin 0.5%, (c) Heptachlor 0.5% and (d) chlordane 1.0%. Other chemicals such as DDT, BHC and PCP may also be used but their effect is not expected to be equally long lasting under all conditions. Soil upto a depth of 30-50 cm around pipline in the trench may be treated.

Rodent Resistance

Doubts are often expressed regarding stability of plastic pipes against rodent attack. In a country like India, where rodent infestation is cosmopolitan, the doubts merit serious consideration.

There are about 70 species of rodents in India such as rats, squirrels, rabbits, mice, etc. They are characterized by the presence of evergrowing incissors. Rats use their teeth for gnawing.

The most common species of rats encountered in India are Rattus-rattus, Rattus-norvegicus, and Bandicota bengalensis. These species are the most common encountered in the vicinity of human habitations. The other species of rodents, such as, squirrels, rabbits, mice, etc., generally do not either bother to damage or they are not capable of damaging. They are limited in number and their fields of activity are different. Therefore, it is generally the rat which may be considered most significant

from the point of view of rodent resistance of plastic pipes.

In a study carried out at this Institute plastic pipe samples were exposed to three species of commensal rats described above. It was seen that Bandicota bengalensis was able to attack LDPE and HDPE pipes. A detailed investigation on attack of rodents on PVC pipes was taken up. Observations are described below :

Nutritive Value

Three sets of exposure tests were carried out for assessing the nutritive value of plastic pipes. In one set ground PVC pipe powder was offered as the only food to rat. It was seen that 30 to 40 per cent rats died due to starvation. The total quantity of PVC powder remained unchanged. In the second set pipes were broken into small pieces and fed to rats mixed with normal bait material of rats. It was seen that only normal bait was consumed by the rats. In the third set small pipe rings were offered to rats when they were maintained on normal food. No damage was noticed. These experiments clearly prove that PVC pipes do not offer any nutritive value to rodents.

Damage to Pipes

Pipe samples were erected in experimental rat pit and exposed to the attack by a batch of 10 rodents of each species for 15 days. Rats were maintained on laboratary food. Pipes with stagnant water and running water were also exposed similarly. No damage of any kind was noticed. Experiments were also conducted to expose pipe samples covered with sand to rats in a specially constructed burrow room. The conditions in the burrow room were so created that the rats could live in their natural way and make burrows, etc. Pipe samples were exposed in the burrow room for one month. No damage was visible.

From these observations it may be concluded that unplasticized PVC pipes do not offer any nutritive value to rodents nor are they damaged by them. However, it remains to be seen as to how PVC pipes will behave when they are exposed repeatedly to attack by rodents in natural conditions over a period of years.

Precautions against Rodent Attack

LDPE and HDPE pipes are susceptible to attack by rodents. These pipes should not be used in exposed conditions where rodent infestation is considered high. Unplasticized PVC pipes are resistant to rodent attack. However, effect of long term field exposure is not yet known. It is recommended that these pipes should be adequately protected from rodents whereever considered necessary. One of the methods may be use of rodenticides, such as, zinc phosphide, barium carbonate, warfarin (i.e., 4 hydroxy coumarine), thio semi carbazide, etc., which may be applied in the form of a protective coating on the pipe surface. These rodenticides are available commercially as powder, solutions, pastes and mixed with food, etc. All these preparations are highly toxic bait to human beings. All recommended precautions must be taken to avoid chances of accidental poisoning.

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need, this Institute is bringing out a series of Building Digests from time to time and the present one is the 140th in the series. Readers are requested to send to the Institute their experience of adopting the suggestions given in this Digest.

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