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Applicator for Bituminous Sealants

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Sealants are employed in buildings to fill the expansion joints and cracks; they accommodate structural and thermal movements and prevent ingress of rain water. In India, normally bitumin-based sealants are used. They are of hot-poured type and are applied with a spetula. Application with a spetula is slow and wasteful, and the performance of the deposits is not satisfactory. An applicator for bituminous sealants has been developed with which sealant is filled under pressure to ensure homogeneous application and to improve its adhesion with the joint faces. The design of the applicator, its constructional details and the method of applying the sealant are described.

The use of sealants in buildings has increased considerably in recent years. The sealants are of two types: one-component type and two-component type. One-component type sealant sets hard on cooling and evaporation of the solvents, while the two-component type sets hard through chemical reaction. Bituminous sealants are commonly used in India. They are of one-component type and are applied with a spetula or simply hot poured in joints in buildings. During heating to pour consistency, the temperature goes up to 180 -200°C. This causes loss of volatiles and change in physical properties of the sealants. Investigations were, therefore, carried out in this institute to develop a suitable mechanical equipment for applying sealants, which may be simple, economical and fast in application.

Design considerations

The main parameters governing the design and development of an equipment for applying the sealent are: (i) viscosity of the sealant, (ii) pressure required for injecting the sealant into the joints and cracks, and (iii) chemical effect of the sealant on metals.

The common constituents of bituminous sealants are residual asphalt, rubber and fillers. The softening point and penetration value of these sealants are in the ranges 60-70°C and 15-30 mm respectively. The apparent viscosity at the softening point is over 1.2×10 cs. It was found that at 25°C, a force of 70 kg/cm^2 is required to make the sealant flow. However, a pressure of 20-25 kg/cm^2 makes the sealant flow at 60-70°C.

Keeping in view the above mentioned parameters, a sealant applicator (Fig. 1) has been designed and developed in this institute. It consists of a hydraulic pump of 2 tonnes capacity, a pressure developing cylinder, cartridges and a nozzle.

Principle of operation

The principle of operation of the applicator is based on the reciprocating motion of the piston into the cylinder. When the hydraulic pump is

operated, a piston is forced into the cartridge filled with the sealant. It pushes the sealant out of the applicator nozzle and comes back with the tensile spring used to bring the ram back against the resistance between the piston and the sealant on the walls of the cartridges. The nozzle helps in forming a uniform bead. The sealant is dispensed through it into the cracks and joints under pressure.

Description of the applicator

A schematic view of the applicator is shown in Fig. 2. It consists of a light and portable hydraulic pump (1) of 2 tonnes capacity which is operated either by hand or foot for developing the pressure. This pressure is transmitted into the pressure developing cylinder (2), which has a ram, tensile spring, connector and coupling for

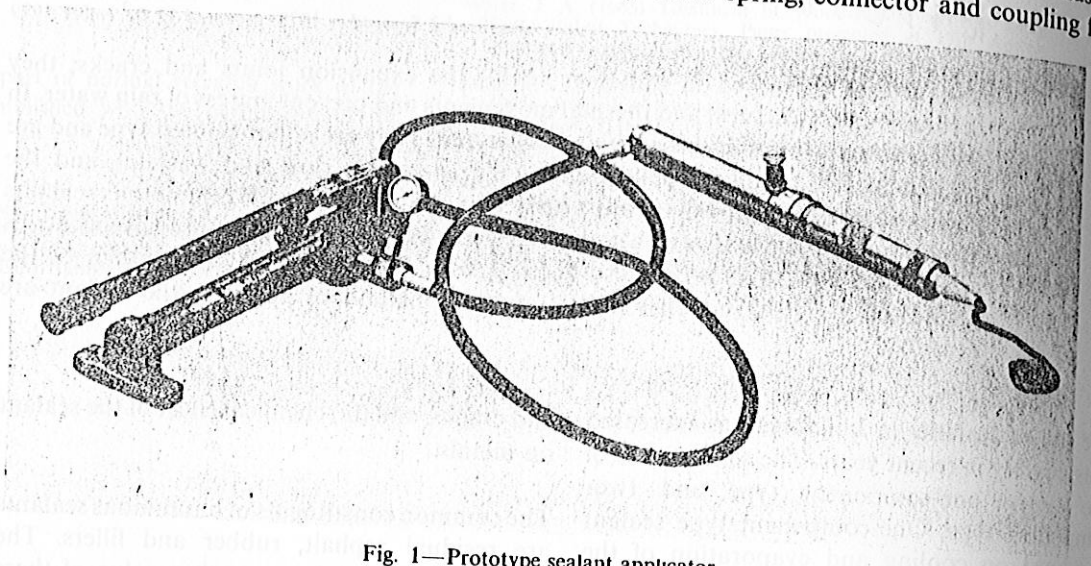

Fig. 1—Prototype sealant applicator

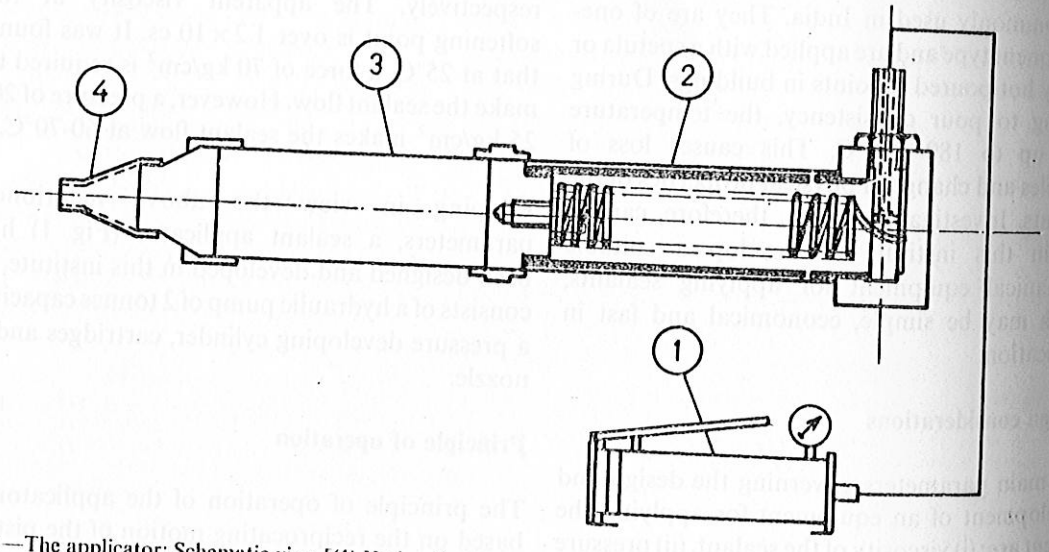

Fig. 2—The applicator: Schematic view [(1) Hydraulic pump; (2) pressure developing cylinder; (3) cartridge; and (4) nozzle]

cartridges. A safety valve is provided to protect the cylinder from damage. This valve also ensures movement of full stroke of the ram. The cartridge (3) consists of a tube of uniform bore threaded at both the ends. The sealing compound is filled into this tube. The nozzle (4) is of tapered bore and fits into the cartridge coupling. The nozzle can be made of different sizes suitable for filling joints of different shapes and widths.

The relevant specifications are as follows:

Length of the applicator	60 cm
Weight of the applicator	5 kg
Design pressure	70 kg/cm^2
Normal working pressure	25-30 kg/cm^2
Hydraulic pump (capacity)	2 tonnes
Temperature at which sealant is poured into the cartridge	90-100°C

Joint and surface preparation

Joints may be of two types: (i) those which occur as inevitable consequences of design, i.e. between door and window frames and the wall and between sections of prefabricated elements; and (ii) those which are introduced deliberately to accommodate major movements in *in situ* constructions. Successful sealing of the joints depends mainly on: (i) geometry of the joint, (ii) surface preparation, and (iii) correct application of the compound.

The geometry of the joint means the shape of the space occupied by the sealant in the joint. It has considerable influence on its performance. Narrow and deep seals produce high strain in the compound and should be avoided. Best results are obtained if the ratio of sealant depth to its width is $\leqslant 1$. It should, however, in no case be greater than 2. For deep joints, a suitable backing material is provided to control the depth of the seal and to provide a step, so that there is adequate pressure build up in the cavity during filling. It also ensures complete filling without voids.

When a backing material is used in joints, a bond breaker, such as a polythene film, is placed between the backing material and the sealant to prevent stress concentration, which may occur if the sealant adheres to the bottom of the cavity.

Concrete and brick surfaces are prepared by wire brushing followed by blowing out the dust with compressed air. The surface should be free from greasy or oily substances. In no case should it be cleaned with water.

Method of application

First the sealant is heated to about 100°C carefully to a flowable consistency and then poured into the cartridge from one end, keeping the other end closed with a cork. A number of cartridges are filled, depending upon the volume of work in hand. These cartridges are placed in warm water (60-70°C) for about 15 min before use. This facilitates injection of the sealant into the joints. It is observed that if pressing by thumb produces a depression of about 3 mm, the material flows well into the joint through the nozzle.

The sealant is best applied if the nozzle of the applicator is placed on the joint at an angle of 60° from the base. When the pump is operated, the pressure is applied on the sealant compound through the pressure developing cylinder. The mass comes out in the form of a thread and fills the joint under pressure. The pressure also helps in consolidating the mass into the joint and ensures its subsequent adhesion with the substrate. The movement of the applicator is synchronized with the rate of flow of the beading. Two persons can carry out the job successfully. For ensuring proper grip and adhesion, it is always better to apply a primer coating of bitumin thinned with kerosene. On vertical surfaces, the application is carried out from top to bottom.

A number of trials were carried out in this

institute. The following results were obtained with a cartridge of 240 mm length and 40 mm diameter:

Weight of the material contained	= 260g
Length of beading coming out of 6 mm diam. nozzle for 1.25 × 1.25 cm section	= 4 m
Time taken in injection	= 6 min.
Filling rate	= 40m/hr
Filling cost (with applicator)	= Rs 0.50/m
Filling cost (with spetula)	= Rs 1.00/m
Saving	= Rs 0.50/m

Salient features of the applicator

(i) It is light and easy to operate.
(ii) It ensures void-free and homogeneous application.
(iii) It prevents wastage and retains material characteristics.
(iv) It can be operated by one man if run by a foot pump.
(v) Sealant application is 50% economical compared to manual filling with spetula.
(vi) The cost of a complete unit is about Rs 3,000.

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References

1 Damusis Adolfas, *Sealants* (Reinhold Publishing Corporation, New York), 1967, 327-361.
2 Meikle T A V, *Building News*, 7 (1971) 52-55.
3 Indian Standard 1934-1961, *Specifications for hot applied sealing compounds for joints in concrete* (Indian Standards Institution, New Delhi), 1961.