

Translation :

The invention as described herein relates to a method for the internal reconditioning of installed conduits. Such conduits are for example supply and discharge conduits for water or gas in residential, industrial and communal installations up to an internal diameter of about 200 mm.; domestic and industrial waste water conduits are included therein.

The problem of the incrustation of such conduits has long been known. Such incrustations are based above all on lime deposits from the water, rust formation in the conduit, other precipitations out of the water, reaction products between substances carried in the water and the conduit metal, etc. Combinations of the stated effects are also known.

Such incrustations have an especially troublesome effect in the case of built-in or under-floor conduits; this type of conduit laying is moreover the more usual nowadays.

Laid utility conduits are even today already cleaned by means of compressed air with and without additional sand, and also reactive resins are already dusted by means of compressed air into conduits pre-cleaned in this way. The inventors of the method as described here have however, had the experience that most such cleanings are based primarily on individual items of knowledge of a craftsmanlike character. Only the combination of the method steps according to the method according to the invention as defined in the patent claims, using the adhesive resin likewise characterised in the patent claims produces the cleaning and internal coating process of utility conduits with an adequately certain effect.

In the case of a relatively known type of cleaning on primarily craftsmanlike basis, compressed air is passed from possibly mobile compressor installations by way of a distributor into the conduit to be cleaned. In a first phase here pre-drying is effected only by means of air heated by compression. Next, in a second phase, sand is added to the air current. It is here essential that the sand-air mixture is conducted in a movement of spiral form through the conduit; a movement of normal form of the mixture is expressly marked as ineffective. In a third phase of the known method then, again by means of a compressed air current moving in spiral form, a reactive resin is injected into the conduit and distributed therein.

GB-A-2.140,337 teaches and claims a method of like classification. It is characteristic thereof that both the cleaning current and the resin throughput current flow in pulsating manner through the conduit to be reconditioned. Moreover the sizes and quantities of the abrasive particles added to the cleaning current are not defined, and the addition of adhesives with likewise defined grain sizes to the reconditioning resin is not mentioned.

More especially the instruction according to GB-A-2,140,337 contains neither an indication of the use of abrasive substances with density  $> 3.0 \text{ g. cm}^{-3}$  (which are harder than the usual deposits in the conduits to be reconditioned) in common with the inorganic adhesives in the resin, nor the input of the resin in the form of a plug, nor the creation of the pressure difference by means of positive and negative pressure. The Applicants are however convinced that the good results which are achieved with their method are specifically attributable to this combination.

The method according to the invention moreover completely dispenses with pulsation of both the cleaning current and the resin current. This pulsation is however the relevant aspect of the method according to the cited GB-A. On the other hand this method is certainly more material-protective and more energy-saving.

The publication in PATENT ABSTRACTS OF JAPAN, Vol. 11, No. 202(C-432)[2649] of the 30th June 1987 does in fact teach the plug-type addition of fluid internal lining materials for conduit reconditionings.

This coating however does not take place in connection with a pre-cleaning in accordance with the application, and the uniform coating is allegedly achieved there by means of tempering of the lining material (and not by means of addition of inorganic adhesives). Such tempering is however practically impossible - according to the conviction of the Applicants - since actually the whole system including conduit would have to be brought to the necessary temperature. Thus even this publication does not make the whole method according to the application obvious.

Compared with the method just described the method according to the invention for the cleaning and new coating of the inner walls of utility water conduits differs firstly fundamentally in that it is optimised as a complete method and therefore also leads to secured results.

The method according to the invention for the accelerated cleaning and new coating of the inner wall of a water conduit is characterised by the following method steps:

drying of the internal space of the conduit by means of permitting the throughflow of pre-dried compressed air.

removal of internal deposits by means of permitting the throughflow of a mixture of compressed air and particles of abrasive agent, the latter with a mean external diameter of 0.8 to 8 mm. and a specific weight of  $> 3.0 \text{ g./cm}^{-3}$  in a proportion of  $> 1.0 \text{ g./Nm}^{-3}$ , with the mixture flowing in the conduit with a mean speed, related to normal pressure, of  $> 10 \text{ m./s}^{-1}$ ,

blowing out of the conduit by means of pre-dried and pre-heated air, until the external temperature of the conduit is  $> 40^\circ \text{ C.}$ ,

internal coating of the conduit by means of the blowing-in and blasting of adhesive resin by flowing compressed air, the adhesive resin being a solvent-free self-setting resin with at least 5 % wt. of inorganic, oxidic adhesive substances with a mean diameter of  $< 0.08$  mm. and its addition into the conduit takes place after preparation in the form of plugs,

where the pressure difference necessary for the flow through the conduit is produced at least partially by sucking away of the air at the end of the conduit, that is by negative pressure.

The adhesive resin to be used according to the invention is a solvent-free 2-component resin and contains at least 5 % wt. of finely divided inorganic, oxidic adhesives and possesses a viscosity at  $25^{\circ}$  C. of at least  $2 \cdot 10^4$  m Pa.s.

The said 2-component resin is preferably an epoxy resin with hardener, and contains as oxidic adhesives, particles of primary  $\text{SiO}_2$  with a lower grain size limit of about 10  $\mu\text{m}$ .

Now for the sake of better understanding of the object of the application by way of example the cleaning of a water supply conduit in a private swimming pool will be reported below. The method there indicated does not correspond however, as regards the abrasive medium used, to the method in accordance with the invention.

After the closing of all branches, the inlet and outlet of the conduit were opened on the preceding day.

On the working day itself the conduit was first pre-dried with compressed air from a site compressor. The compressed air was pre-dried in a moisture separator, before entry into the conduit.

The necessary quantity of air appeared (as also subsequently for the cleaning and coating) from the following table :

|                            |                          |                 |
|----------------------------|--------------------------|-----------------|
| NW 15mm./ $\frac{1}{2}$ "  | Pipe length up to 100 m. | 7.5 cu.m./min.  |
| NW 20mm./ $\frac{3}{4}$ "  | "                        | 7.5 cu.m./min.  |
| NW 25mm./1"                | "                        | 7.5 cu.m./min.  |
| NW 32mm./5/4"              | "                        | 10 cu.m./min.   |
| NW 40mm./1 $\frac{1}{2}$ " | "                        | 14.0 cu.m./min. |
| NW 50mm./2"                | "                        | 17.0 cu.m./min. |
| NW 65mm./2 $\frac{1}{2}$ " | "                        | 24.0 cu.m./min. |
| NW 80mm./3"                | "                        | 26.0 cu.m./min. |
| NW 100mm./4"               | "                        | 30.0 cu.m./min. |
| NW 125mm./5"               | "                        | 35.0 cu.m./min. |
| NW 150mm./6"               | "                        | 45.0 cu.m./min. |

The delivered quantities of air can admittedly vary greatly, according to the quantity of the branches and the degree of incrustation of the conduit.

In the present case the total length of the conduit amounted to about 70 m.; it consisted mainly of 1" and 1½" pipes. The conduit was in part built-in and in part laid in the open under-floor.

The pre-drying lasted about 30 minutes. On the conduit exit a special separator was fitted; the emerging fine solid (apparently mainly lime precipitations and rust) passed into a special separator.

Next a feed device for the abrasive medium (dry normal sand of 2 to 4 mm. grain size) was installed into the conduit between compressor and air entry. At the air exit a separator with cyclone separator with manometer and regulating valve was installed. Thereupon work was continued for app. 8 minutes long at an average excess pressure of about 1 atmosphere with maximum compressor power and addition of abrasive. After the blowing about 200 kg. of abrasive had been blown through the conduit to be cleaned. At the end of the blowing the air at the exit from the separator displayed a temperature of app. 50° C.

After brief flowing out batches were prepared each of 4 kg. of adhesive resin of the following preparation: the resin was prepared each time so that it displayed a viscosity of over  $2 \cdot 10^4$  m Pa.s at about 25° C. As plug the batches were then poured into the air entry pipe (vertical) at the beginning of the conduit. Then immediately the compressed air was applied and the plug was blown until no distinct resistance was traceable any more. Thereupon a further resin plug was introduced, and so forth, four times in all. Only then was an escape of resin from the conduit end ascertained.

#### Basic recipe for LSE coating

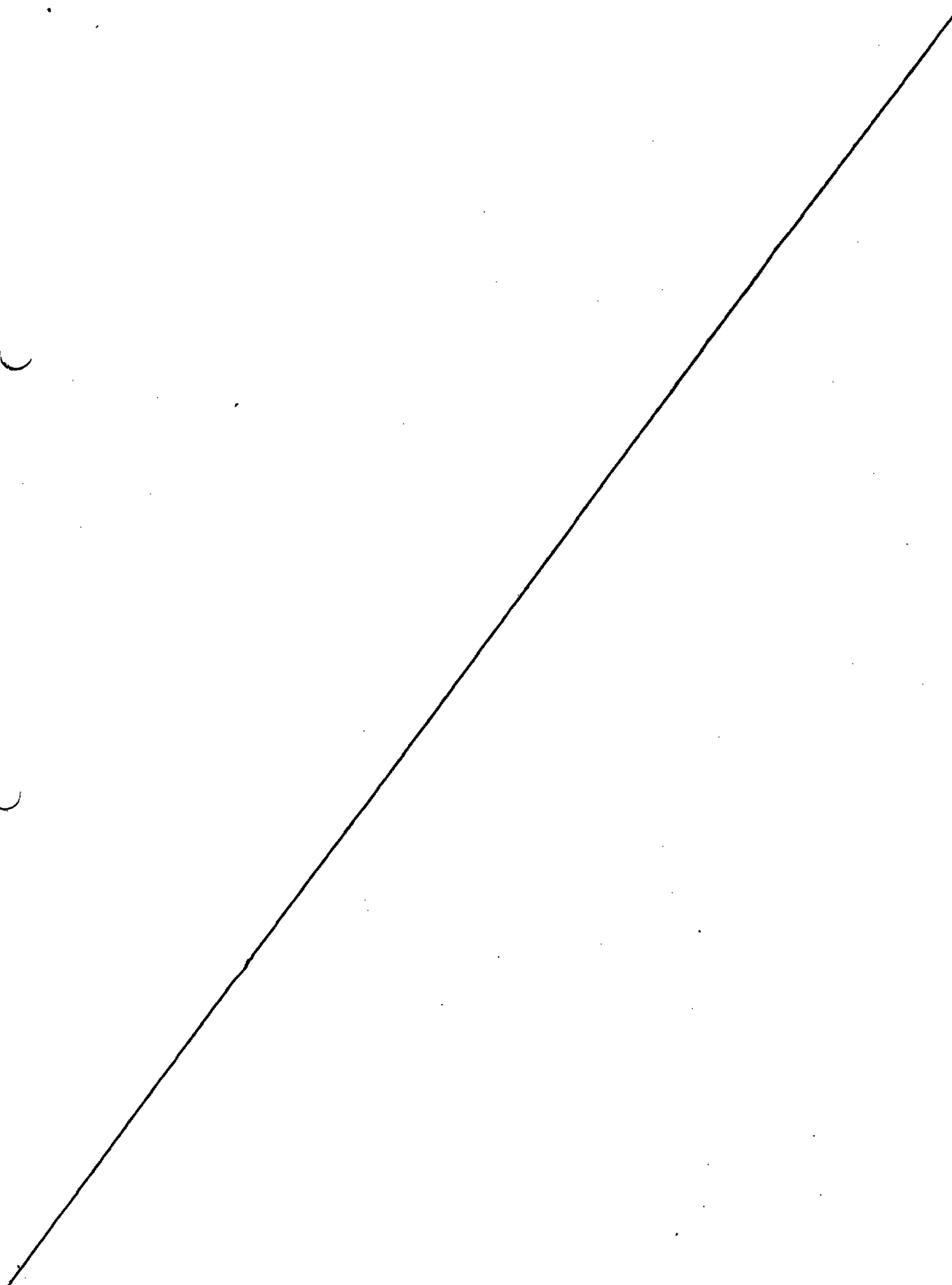
|                         |                            |         |
|-------------------------|----------------------------|---------|
| Epoxy resin             | Bis-A or Bis-A/F type      | 47 G %  |
| Hardener                | aliphatic polyamine adduct | 19 G %  |
| titanium dioxide        |                            | 4 G %   |
| red iron oxide          |                            | 10 G %  |
| silicate filler         |                            | 15 G %  |
| thixotroping (silicate) |                            | 5 G %   |
| total                   |                            | 100 G % |

Next blowing through was again effected for 30 min. and the conduit was closed at top and bottom at the end of the blowing time.

2 days later the conduit was again connected to the mains and first washed through well.

One basin filling lasted about 8 hours after cleaning of the conduit and produced clear water; before the cleaning

a filling lasted over 14 hours, and the water was in part coloured rusty red.



# P A T E N T   C L A I M S

1.) Method for the internal reconditioning of installed conduits, with the following method steps : -

drying of the internal space of the conduit by means of permitting the throughflow of pre-dried compressed air.

removal of internal deposits by means of permitting the throughflow of a mixture of compressed air and particles of abrasive agent, the latter with a mean external diameter of 0.8 to 8 mm. and a specific weight of  $> 3.0 \text{ g./cm.}^{-3}$  in a proportion of  $> 1.0 \text{ g./Nm}^{-3}$ , while the mixture is flowing in the conduit with a mean speed, related to normal pressure, of  $> 10 \text{ m./s}^{-1}$ ,

blowing out of the conduit by means of pre-dried and pre-heated air, until the external temperature of the conduit is  $> 40^\circ \text{ C.}$ ,

internal coating of the conduit by means of the blowing-in and blasting of adhesive resin by flowing compressed air, the adhesive resin being a solvent-free self-setting resin with at least 5 % wt. of inorganic, oxidic adhesive substances with a mean diameter of  $< 0.08 \text{ mm.}$  and its addition into the conduit takes place after preparation in the form of plugs,

where the pressure difference necessary for the flow through the conduit is produced at least partially by sucking away of the air at the end of the conduit, that is by negative pressure.

2.) Method according to Patent Claim 1, in which the abrasive medium particles have a mean diameter of 2 to 4 mm.

3.) Method according to Patent Claim 1, in which the mean air speed, related to normal pressure, amounts to  $> 50 \text{ m./s.}$

4.) Method according to Patent Claim 1, in which the adhesive resin is a 2-component resin, especially an epoxy resin with hardener, the viscosity of which at  $25^\circ \text{ C}$  amounts to more than  $2 \cdot 10^4 \text{ m Pa / s.}$



\* C L M S \*