

MICHIGAN DEPARTMENT
OF
STATE HIGHWAYS AND TRANSPORTATION

FINAL REPORT
SYLVAX U.P.M. PATCHING MATERIAL
JANUARY, 1977

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SYLVAX UPM PATCHING MATERIAL

DECEMBER, 1976

FOREWORD

The testing of Sylvax UPM cold patching was to determine its qualities when used under actual field conditions. We were concerned with the following categories:

- A. Handling and workability during cold weather and wet conditions.
- B. Duration and quality of its storage ability.
- C. Ability to stay in place once installed.

CONCLUSION

Sylvax is a desirable emergency patching material. It must be applied with reasonable care and on an existing surface which would provide a chance of staying in place. Its staying ability is superior to any of our other premixed materials when applied under similar adverse conditions. The costs prohibits indiscriminate use (a) when existing conditions will not support a patch; (b) where free water will penetrate prior to complete compaction; (c) when time or conditions do not permit proper installation.

Sylvax's stockpile life, its workability, and its ability to adhere to a wet surface establishes it as a desirable emergency patching material. The possibility of producing the Sylvax material for emergency patching with our own forces should be investigated and evaluated.

COST

The average price of Sylvax material purchased last year was \$52 per ton. This was in comparison to an average of \$15 per ton for regular CP material. Both prices include hauling charges to destination (see Figure 6).

Figure 5 shows the daily average cost for a three-man crew at current material prices. Based on the average patrol patching crew, the material cost represents approximately 38% of the total cost of the operation. The only justification for using the more expensive material is the extended period of time that the emergency patch stays in place. Our tests have verified a six month survival rate of 82% for the Sylvax material.

Because of the wide range of producers and variances in materials and procedures, we cannot establish a positive survival rate for other cold patching material. The chart (figure 9) shows the cost per ton of Sylvax in place for a six month period in comparison to the various survival periods for CP material. The rate of failure for CP material - emergency patches for a 1-7 day period have varied from 9% to 100%. Once a patch has been made and remained in place for the initial 7 day period, the chances of lasting 6 months are very good.

The chart is based on the first 6 months of patch life assuming that after this period the failure would be caused by other conditions rather than the fault of the patching material.

EVALUATION OF TESTS

Six Month Period

Our Interim Sylvax Report of July 15, 1975 included six months evaluation. The results were quoted as follows:

"We have a total of 69 recorded patches - 82% or 57 of the original Sylvax patches are in acceptable condition. The general shape of the original patch is still in place and servicing its intended purpose. The surface was considered acceptable if the settlement was less than 3/4".

18% of the original patches have failed. To determine the definite cause of failure of each of the individual patches is impractical, but additional failure of existing surfaces is a major factor. The survey shows that of the 57 Sylvax patches that are now in acceptable condition, approximately 50% of the general areas are in need of some additional attention. The failure of the existing surfaces which caused the original hole will continue (see Figure 4). This deteriorating condition will continue and will require additional patching. These failures are the result of existing surfaces and not the fault of the current patching material."

One Year Period

A summary of results at the end of one year are as follows:

1. 64% (44) of the original patches had failed or the general area had received major repairs.
2. 36% (25) of the original 69 patches recorded were in acceptable condition. As previously stated, a patch was considered acceptable if it was less than 3/4" low and had remained in place so that the original shape could be recognized from the photos and description.

The survey was conducted of the original recorded patches approximately one year after installation. This was after one completed construction season and after the close of the maintenance concrete and seal patching programs. Below are the results of the survey of the 57 patches that have survived the first six month period.

The identity of 32 test patches was lost through repairs that were made by one of the three following methods:

1. Complete joint removal and replacement with concrete by contractor or maintenance forces.
2. Area included as part of a resurfacing program and covered with a bituminous resurfacing.

3. Repaired by maintenance forces by seal patching the general areas or covered by a bituminous mix overlay. During this six month period, the identity of 32 individual patches had been lost.

Two Year Period

After two years of service, the survival rate of the original 69 test patches had been reduced to 6 patches (approximately 9%). The six patches can be classified as acceptable condition and the identification positively established. The balance of the patching cannot be declared a failure of the patching material but rather the identity had been lost through one of the previously described repairs. The 9% survival of the original patches were all placed on sound existing surfaces on which additional failures had not occurred (see Figure 3).

BACKGROUND INFORMATION

The Sylvax material originated in the Eastern States and had limited use during the early 70's. The Department used approximately 3,500 tons during the past 27 months, starting in October, 1974. All materials were produced by contractors and made according to specification for C.P.1, modified to permit the Sylvax additive (see Figures 1 & 2). The specifications have remained the same for the duration of the test. The intent of the specification was to obtain a binder for cold patch mixture that could be stored for a minimum of six months and remain workable at temperatures down to 15°F. The binder was to have properties which would permit it to be placed under cold and damp conditions. The aggregate was a 100% crushed stone of 31 gradation and all the bituminous material and additives were supplied directly by the Sylvax Company.

TEST PLAN

During the first year, tests were carried out at 16 various garage sites located in the southern half of the Lower Peninsula. This portion of the test involved 1,000 tons of material. The second year the program was expanded to include all direct areas within the State and involved an additional 2,500 tons.

The object of the test was to determine the material's working ability and its ability to stay in place after installation. The design of the test required that in the first year each garage site would establish a series of 3-5 patches during the late fall and another series in January, during adverse weather conditions. If possible, a third series would be established in early Spring. Each patch was to have positive identification and a designated spot where a picture could be taken. The purpose of the picture was to provide a positive record of the results of each patch. Each patch location was identified and a record established of weather conditions and existing surfaces, together with information on surface preparation and the method of application. During the second year of the test (October 1975 - December 1976) this same process was repeated on a limited number of patches at additional locations.

APPLICATION - OBSERVATIONS

The extended testing confirmed our findings as stated in the Interim Report. Observation of the test patches and examination of our installation records, we have determined that Sylvax material will serve well for emergency patching during adverse weather conditions; it will adhere to an existing clean surface that is moist or slightly wet.

The material, when applied, does not require a vertical edge. It may be applied to a depressed area and the edges tapered. It will taper to approximately 3/8" or the maximum size of the aggregate. The hole or area to be patched must be sound and free of dirt or loose material. Loose material or unsound existing surface will result in failure--the same as with any other cold patching material. Priming of the hole is not necessary or, to our knowledge, even desirable.

From our observations, proper compaction is a crucial factor. Without adequate compaction, the patches will settle 10% to 20%. Low patches are common throughout the test program. Patches that have settled to the point that they require wedging can be corrected with the addition of more Sylvax. The edge will adhere well and blend in with the original patch. The best results have been obtained when the patches have been rolled with truck tires. The combination of pneumatic rolling and repeated luting will result in a smooth surface and well compacted patch. It is our impression that the slow constant pressure of the rubber tired wheel is advantageous to the sharp impact caused by a hand tamp or compaction with a shovel.

An extensive failure which has been properly prepared and compacted on a reasonably sound base will provide a serviceable patch for one year or more (see Figure 8).

Throughout the tests, it was observed that emergency patching is required in areas where the pavement is in a general unsound condition. The area usually has been patched repeatedly and will require permanent repairs when time and weather permits, and hot mix or concrete is available. The important staying period for emergency patching material is from a 1 to 7 day period. If an emergency patch which is placed during adverse weather conditions survives the first week after installation, it will usually make the 6 month to 1 year period. Beyond the 1 year period, corrections are usually part of construction or one of the maintenance repair programs. An emergency patch which remains for this period usually will remain until the adjacent surface fails (see Figure 3).

In our opinion, the failure of the Sylvax material to stay in place is directly related to one or more of the following factors:

1. The material was placed on a loose or unsound surface.
2. Free water penetrated the fresh patch before it had become compacted by traffic.

3. Failure to obtain adequate initial compaction.
4. Base failure that causes the surface to move.
5. Surface failure adjacent to the original patch.

STOCKPILING

To evaluate Sylvax abilities to be stored during the winter season, a stockpile was placed at Battle Creek garage on December 11, 1974 (see Figure 7). Shortly after, the height of the pile was measured to determine the degree of settlement. This measurement was checked at various times throughout the winter with little or no change of height. Apparently no settlement had taken place or the pile had not spread out. The original pile remained intact throughout the winter months with little change in general appearance. The slight crust which formed on the outside is only about 1" in depth, and while it has lost its outside gloss, it is still flexible and can be shoveled with a minimum of effort.

On January 31, 1975, an inspection was made to evaluate the material's workability below freezing temperatures. In 30° weather and bright sunshine the square point shovel can be thrust into the material in a matter of a few seconds. This permits hard-loading of an exposed pile if desired. In the direct sunlight, the material feels soft under foot and with a little pressure and with a rotating motion, the material will appear to move easily.

Under these conditions, a front end loader can also be used and can pick up a full bucket by exerting a little pressure and operating slowly. At lower temperatures and without the direct sun, the action is the same but material is firmer and requires a little more time to get the same reaction.

The material remained in the stockpile until the Spring of 1975, approximately 7 months. It was then loaded with the loader, hauled, and placed in a second stockpile. All of the material was used within the following 3 months. In the process of loading and hauling, the crust which formed in the first 7 month period mixed with the rest of the material and was not evident when it was used in the field. The material worked easily and remained in place after installation. In one instance a small amount of the 1974 material remained in stockpile for two years. This stockpile was oxidized on the surface and crusted to a depth of about 3". After loading and hauling the 2 year old material, the oxidation and crust again was not evident. The material was workable and the results were satisfactory. The storage ability and the workability of the Sylvax material is satisfactory. This is the one factor that consistently draws favorable comment. We can safely state that the storage for the Sylvax material is in excess of one year without any noticeable deterioration.

PRODUCING MATERIAL

All Sylvax material used has been produced by contractors under the supervision of a Sylvax representative. It was made in accordance with C.P.1 modified specs with a lime stone for aggregate. The bitumen and additive were provided by Sylvax Company.

There is still a problem maintaining a consistent material (see Figure 4 tracking) from the various producers. The variation is less than earlier experience but is still a factor to consider. From information available from factory representatives and thorough contact with other agencies, the production of Sylvax can be accomplished on a limited basis with portable type equipment. A program in which we would produce our own emergency material appears possible and should be investigated.

Some of the areas in producing it ourselves which may be advantageous to the Department would be:

1. reduction in material cost
2. material would be available at all locations
3. material could be produced as needed
4. all local aggregate used
5. reduce hauling requirements for delivery
6. coordinate production of material to utilize local work forces

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

SPECIFICATION

FOR

BITUMINOUS PATCHING MATERIALS

CP-1 MODIFIED

(for Experimental Use)

DESCRIPTION

This work shall consist of producing and delivering bituminous patching materials as specified herein to stockpiles at the sites and in the amounts described in the Proposal.

MATERIAL

The aggregate materials shall meet the requirements specified in Division 8 of the 1973 Standard Specifications for Highway Construction as follows:

Coarse Aggregate	31A or 31C	8.02
Fine Aggregate	3FS or 3CS	8.02

Bituminous material shall be Sylvax UPM or equal as approved by the Engineer and shall meet the following requirements for Asphalt Binder for Cold Patch Mixtures.

Description: The intent of these specifications is to obtain a binder for a cold patching mixture which can be stored for six months and remain workable at temperatures of 15° F. The binder shall have such properties as to permit the placement of the mixture under damp conditions. Failure of the mixture to perform to the satisfaction of the Engineer shall be grounds for cancellation of future deliveries. The low bidder shall supply a sample of this binder for evaluation purposes when so requested.

Specific Requirements:

Flash Point	65.6° C
Viscosity, Furol sec. @ 60° C	125-250

Distillation Requirements	
to 225° C	0-10% of distillate
to 260° C	15-55% of distillate
to 315.5° C	60-87% of distillate
Residue @ 360° C	67% +
Penetration of Residue	
25° C 100 g. 5 sec.	120-250
Ductility of Residue:	100+
Solubility of Residue in Trichloro-ethylene	
	99.5%
*Coating and Stripping Tests	
(ASTM D-1664)	Passes

The binder shall not release any water when combined with the aggregate in the mixture.

*Aggregate used in these tests shall be a crushed gravel or limestone.

MIXTURE PROPORTIONING AND PREPARATION

Bituminous Patching Mixture CP-1 Modified shall be proportioned and prepared in accordance with Bituminous Patching Mixtures, 7.11 of the Standard Specifications for Highway Construction with the following exceptions:

The mixture shall conform to the composition limits specified for Bituminous Patching Mixture CP-1 except that the bitumen content shall be 6⁺ 1/2 percent. The temperature of the bituminous material shall be not less than 175° F or more than 275° F and the temperature of the aggregates shall be not less than 90° F or more than 110° F when incorporated into the bituminous mixture.

The stripping test as specified for application to the bituminous mixture will be performed as specified under Stripping Test 7.11.06 except that it will be evaluated for 90 percent asphalt retention and in lieu of distilled water a solution of 2 ounces of Westolite (as made by West Chemical Product, Incorporated) per gallon of soft water will be used.

METHOD OF MEASUREMENT

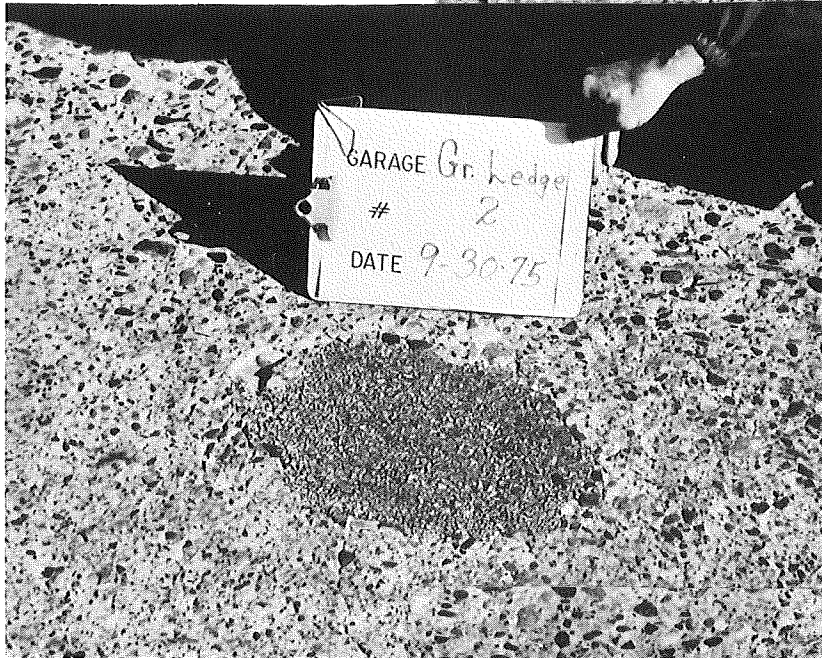
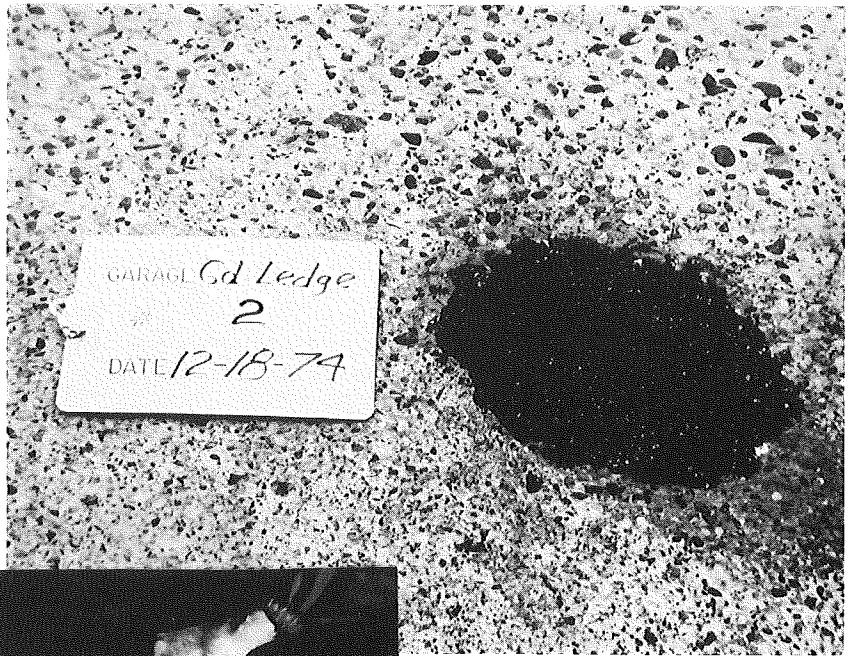
Bituminous Patching Mixture CP-1 Modified will be measured by weight in tons.

BASIS OF PAYMENT

The completed work as measured for Bituminous Patching Mixture will be paid for at the contract unit price for the following contract item (Pay Item).

<u>Pay Item</u>	<u>Pay Unit</u>
Bituminous Patching Mixture CP-1 Modified	Ton

GOOD EXISTING SURFACE



SOME CHANGE

SAME - STILL GOOD AFTER 2 YEARS

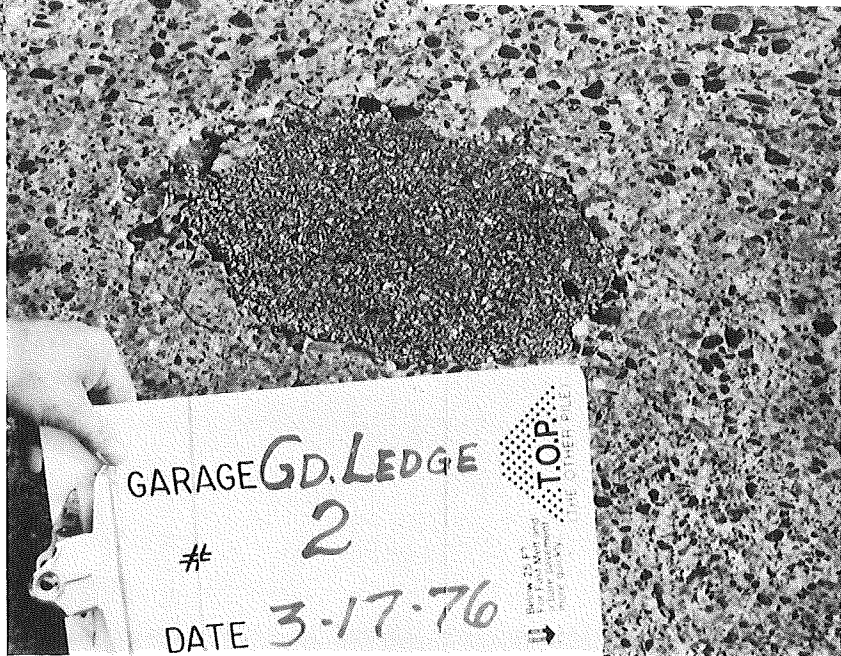
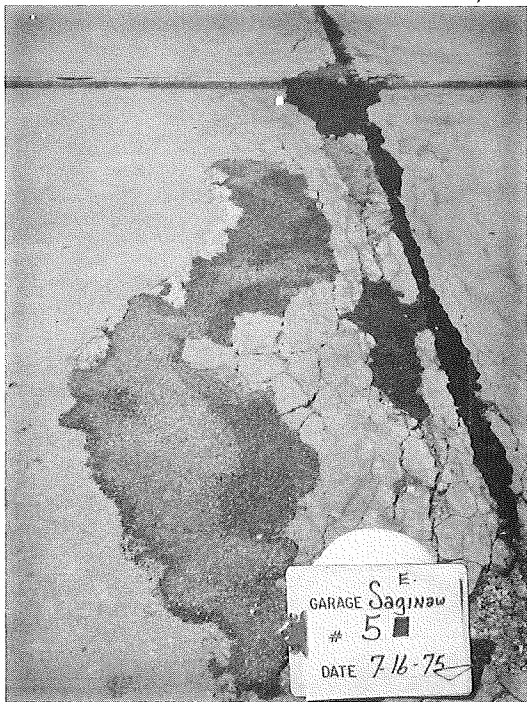


FIGURE 3



TYPICAL EMERGENCY PATCHES

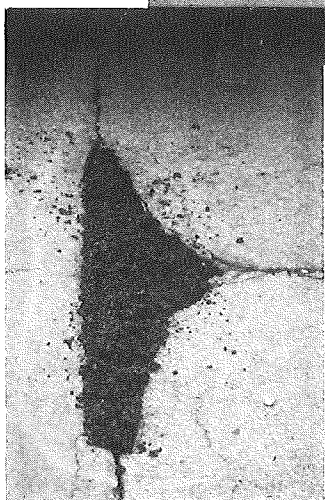


LOW PATCHES COMMON

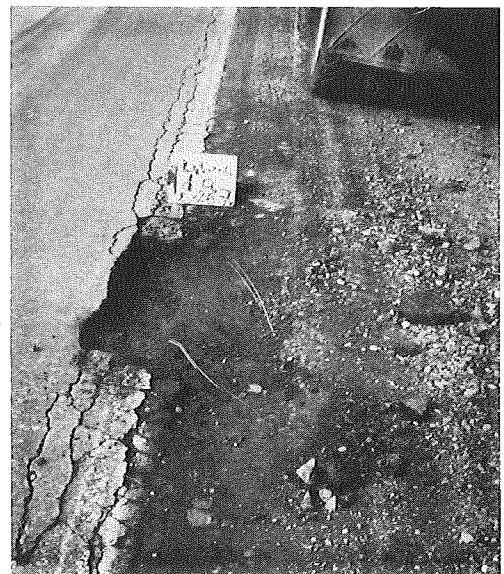
INCONSISTANT MIX
- NOTE TRACKING



LOST PATCHES EXPECTED



WORKABLE MATERIAL
STOCKPILED 1 YEAR



EDGE PATCH -
USE CHEAP MATERIAL

FIGURE 4

AVERAGE PATROL PATCHING COST

	<u>C.P. - 1</u>	<u>Sylvax</u>
<u>Labor</u> 3 men, 8 hours	\$134.88	\$134.88
<u>Equipment</u> 1 truck	30.56	30.56
<u>Material</u> (Average 1.95 tons per day)	29.25	101.40
<u>Average Daily Cost</u>	194.69	266.84
<u>Premix Material Cost</u>		
C.P. - 1 Statewide average cost	\$15.00 per ton	
Sylvax Statewide average cost	\$52.00 per ton	

FIGURE 5.

Patrol Patching Average Daily Cost

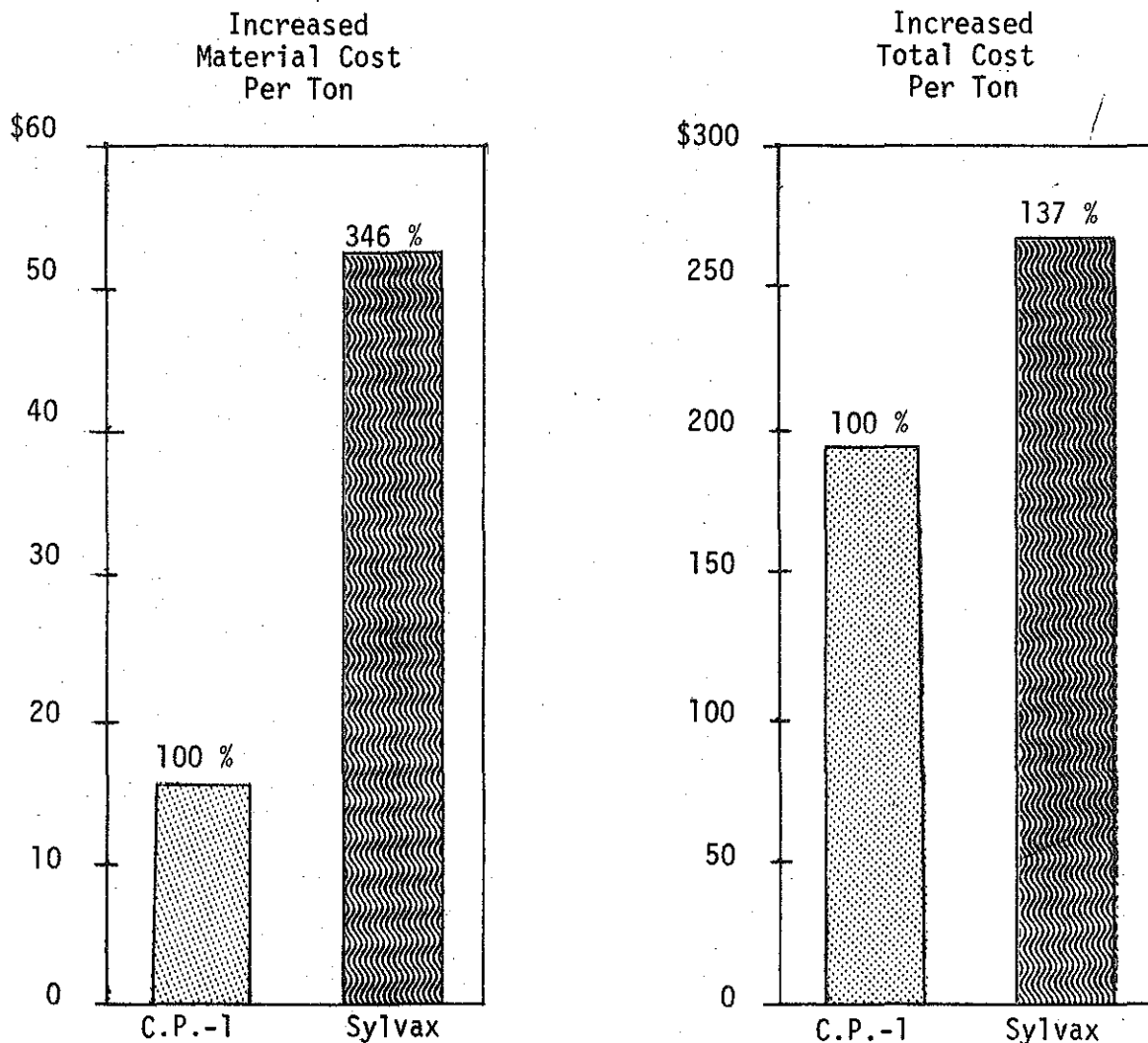
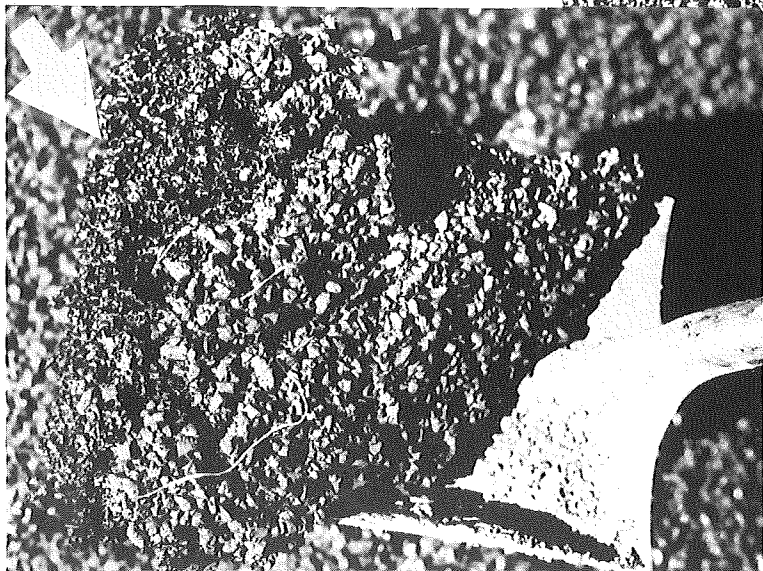


FIGURE 6

Pliable
Under
Pressure



Little Change
in Appearance

No Settling



Easily Loaded

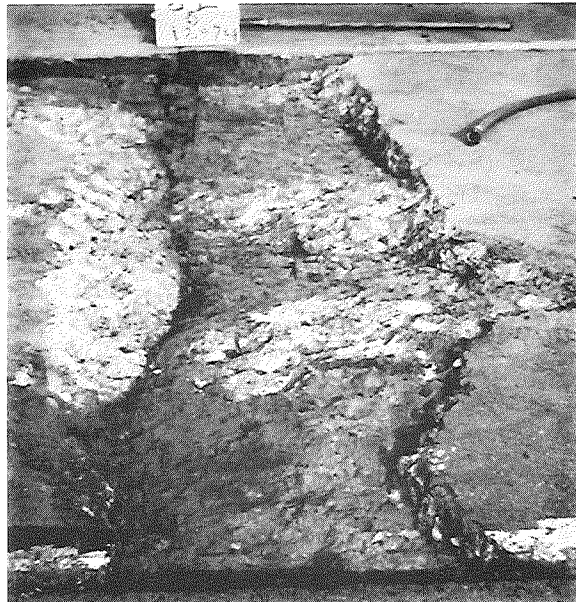
Fig. 7

DECEMBER 1974

PROBLEM

PREPARED

REPAIRED



GOOD

FAIR

16 MONTH



FIGURE 8

COST/TON PATCHING (IN PLACE)

SYLVAX vs CP-1

FOR 6 MO. PERIOD AT
VARIOUS % OF SURVIVAL

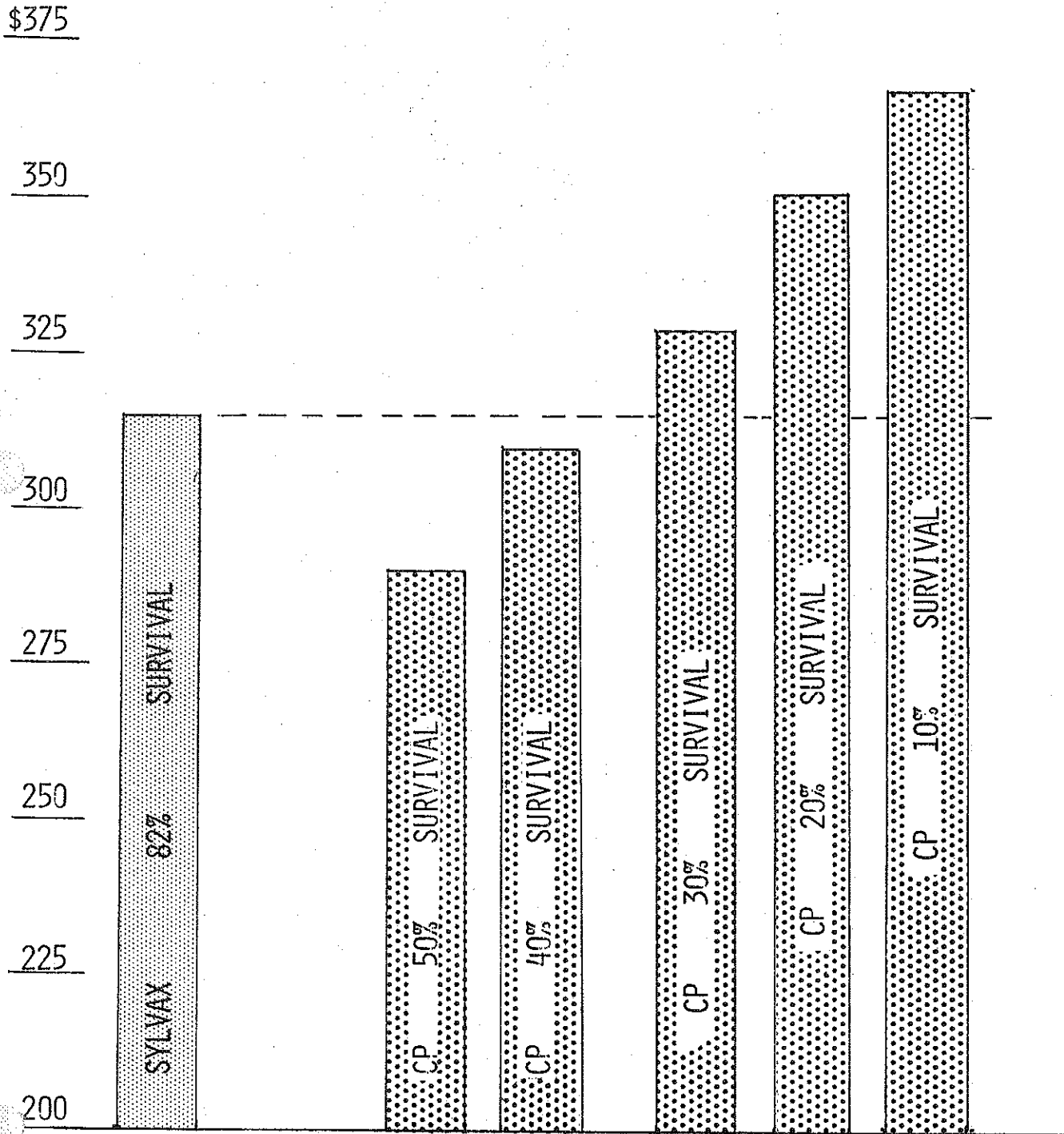


FIGURE 9