

- Rutting and Rolling of Asphalt Pavements H W Skidmore, Municipal and County Engineering, Vol 62, p 4
- Bumps and Waves in Bituminous Pavements W L Hempelman, Municipal Engineering, Vol 54, April, 1918, p 138
- Asphalt Pavements and Remedies for Creeping M L Patzig, Engineering and Contracting, Vol 59, Feb 7, 1923, p 350
- A Study of Topeka Mixed Bituminous Pavement Specifications. R M Green, Engineering News-Record, Vol 87, 1921, p 728
- Shoving of Asphalt Pavements Over-Emphasized Prevost Hubbard, Engineering News-Record, Vol 93, No 22, p 862 (Nov 27, 1924)
- Compositions of Principal Types of Asphaltic Road Surfaces Compared R Feret, Bull of Permanent International Assn of Road Congresses, No 33, May-June 1924, p 1003
- Asphalt Mixtures Chicago Heavy Traffic Street Tests H W Skidmore, Engineering News-Record, Vol 91, p 1060, (Dec 27, 1923)

RECOVERING BITUMINOUS MATERIAL FROM AGGREGATES WITHOUT CHANGING ITS CHARACTER

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In presenting a report on this subject, the writer has attempted to collect published methods on the subject and opinions from various authorities engaged in this field of investigation with the object of presenting a summation of what has been accomplished on the problem. In the general study of the life of highway surfaces, the desirability of having a reliable method by which bitumen could be recovered with the certainty that it had not been changed in the recovery operation is apparent to all, but although several methods have been published, there is comparatively little data available to show exactly how much reliance can be placed on the results of tests on the recovered product. The methods which have perhaps had the largest publicity are presented in the order of their publication.

A W Dow¹ appears to have first outlined a definite procedure, having in mind principally the recovery of the pure bitumen from native asphalts carrying high percentages of mineral matter, with the notation of its value for the recovery of bitumen from bituminous aggregates. Briefly, his method involves digestion of the bituminous aggregate in cold carbon disulphide, sedimentation, and decantation of the solution of bitumen, from which the bulk of the solvent is removed by flask distillation, and the last traces by the addition of a very small amount of water and further heating. Dow comments as follows:

"It is doubtful whether in all cases the last traces of carbon disulphide are removed, even by this method, and it is also likely that the pure bitumen obtained in this way is often slightly harder than that contained in the original asphalt or cement, but its physical properties as far as ductility and susceptibility to change in temperature go, will be relatively the same, and a sufficiently close approximation can be made of the consistency of the bitumen in the original sample to answer all practical purposes."

¹ Proc A S T M 1903, Vol 3, p 360

The next published method which we have noted is that of Clifford Richardson,² which follows in general that of Dow using carbon disulphide, but omitting the water treatment, and completing the evaporation of the unknown sample along with a control sample of the same general character and of known consistency that has been carried through the extraction process simultaneously. When the control has been brought to its original consistency the recovery of the unknown is considered completed. Richardson's only comment is that this determination is reliable within five points on duplicate determinations.

Hubbard and Reeve,³ describe a method for extracting the bitumen by washing the bituminous aggregate with cold carbon disulphide in a centrifuge extractor. The apparatus consists of an iron bowl inverted on a brass plate with a felt ring acting as a filter between the edge of the bowl and the face of the plate. Centrifuging with repeated additions of the solvent, forces the solution of bitumen through the felt.

Their method of recovering the bitumen consists in merely distilling off the solvent until no traces can be detected by a flash test, and then heating the residue in a hot air oven at 105°C for about one hour. No comments are offered but it is understood that the authors considered it about as reliable as either of the previous methods.

Committee D-8 on Waterproofing, of the American Society for Testing Materials, recommend the use of the New York Testing Laboratory extractor⁴ for the extraction of bituminous mastics. This is of the reflux type. Where the properties of the extracted bituminous matter are to be determined, 500 g. of mastic shall be taken and extracted with pure benzol. By weighing the extracted aggregate, the weight of bitumen extracted is determined by difference, and the benzol solution is evaporated until exactly this weight is reached.

The method calls attention to the fact that it is especially adapted for asphalt mastics, grouts and mastic cakes, and that if the binder is coal-tar pitch, the "free carbon" constituent of the binder will remain with the mineral aggregate. This, of course applies to all of the above methods, to overcome this difficulty a somewhat unique method has been worked out by Walczak and Rice⁵. This method is based on the specific gravity of the two substances, bitumen and mineral aggregate, each mutually insoluble in the other. The bitumen of relatively low specific gravity and the mineral matter of high specific gravity are separated by the use of a solution of an approximately inert salt, of a gravity intermediate between the other two materials, thereby floating the bitumen and allowing the mineral matter to remain as a sediment. The authors describe an apparatus for accomplishing this result and for collecting the liberated bitumen. Their results show the recovery of the tar bitumen in substantially its true state as existing in the mixture,

² The Modern Asphalt Pavement, 1st Edition (1907), p 512

³ U S Dept of Agriculture, Bull No 314, p 37

⁴ A S T M Tentative Standard D147-23T

⁵ Jour Ind and Eng Chem, Vol 12, No 8, p 738, August, 1920

and suggest its use, possibly with slight modifications, for asphalt binders

Correspondence with a number of workers in this field, whose opinions would prove most authoritative, has failed to bring forth any very positive assurance that the bituminous material can be recovered from mixtures without changing its character, to some extent at least, in the process of the recovery. That the changes will be greater in some materials than others is without question. Native asphalt binders normally carrying large percentages of mineral matter will be deprived of this natural filler in the extraction process, and to this extent they will be changed. To recover such products in their natural states appears to be an almost insurmountable problem. Tar products will similarly be changed by precipitation and removal of "free carbon" in any of the processes involving filtration or sedimentation, but for these the method of Walczak and Rice offers possibilities of success. This method offers a possible means of recovering cut-back products which may still carry some residual solvent that would be lost in any process involving evaporation at elevated temperatures. The value of this method for recovering harder pitches and asphalts has not been demonstrated, although one correspondent writes of inability to separate the asphalt from the aggregate by this means.

The preferred procedure as evidenced at this time may be summed up about as follows

Solvent Benzol generally preferred with fairly well-expressed opinion that carbon disulphide reacts to some extent with the bitumen

Extraction Centrifuge extractors of the Rotarex type or reflux apparatus of the New York Testing Laboratory preferred over sedimentation methods, although for complete elimination of fine mineral matter, sedimentation may have to follow treatment in extractors

Recovery Probably A S T M method has more support than any other single method at this time, although it remains to be seen how reliable it will prove now that it has become circulated. The complete removal of solvent in many cases is admittedly difficult, and there is still some support for Dow's procedure of removing the last traces by the addition of a small amount of water. This effects a quick steam distillation which with benzol is very effective.

The above comments apply to bituminous aggregates in which the binder is asphaltic. For tar products, the method of Walczak and Rice is the only one which has come to the writer's notice.

Taking the salient features of the above methods as a basis for experiments, a comprehensive series of results on known samples of representative binders recovered from solution would be of value in enabling one to predict how closely he would be justified in interpreting results on samples of aggregates under examination.

The Economic Selection of Road Building Material by W. E. Hawkins, of the North Carolina State Highway Commission, was the next paper

on the program This paper has been printed in full in the North Carolina Highway Bulletin for December, 1924

The paper by Mr Hawkins was discussed by G W Hutchinson, former testing engineer of North Carolina, Harry Tucker, of the North Carolina State College, and Tyrrell B Shertzer of the Ohio Dolomite Association These discussions cited many practical instances of the selection of road building materials