

NEEDED RESEARCH ON ASPHALTIC ROAD MATERIALS

BY E F KELLEY

Chief, Division of Tests, U. S. Bureau of Public Roads

SYNOPSIS

The term "asphaltic materials," as used in this discussion, covers the range of liquid, semi-solid, and solid asphaltic products used in road construction. In chemical composition, asphaltic materials are varied and complex and almost numberless varieties may result from different materials and methods of refining. This complexity gives rise to the problems which confront us.

Some tests for asphaltic materials are intended to measure certain qualities directly, others are identification tests. Further research is necessary to determine in which category some tests belong. Investigation is also needed to determine if tests intended to measure quality actually do so. There is evidence to show that ductility tests and tests designed to control susceptibility to temperature changes are not directly related to service behavior. A high degree of durability is very important and little concerning this quality can be foretold from present test methods.

Further research is needed to determine how the characteristics of the crude oils influence the quality of the finished products. Closely allied with these questions are the problems which arise from different methods of refining.

Heating, mixing and placing asphaltic materials alter their characteristics. It is necessary to determine to what extent such changes may be permitted without damage to the quality of the finished product.

In addition to research on the asphaltic materials, it is necessary to study the inter-relation between them and the aggregates. Study is also needed on new uses for bituminous materials such as stabilization of soils.

When the details of needed research are considered the problem becomes enormously complex. The combined efforts of all interested in the production and use of these materials are required if results are to be achieved in a reasonable length of time.

The term "asphaltic material," as used in this discussion, is all-inclusive and covers the range of liquid, semi-solid and solid asphaltic products which are used in road construction. It is a term which is about as descriptive of the character of the material as the word "stone" is descriptive of the material which forms a large portion of the earth's crust. In chemical composition asphaltic materials are varied and complex and almost numberless varieties may result from the use of different crude materials and dif-

ferent methods of refining. It is this complexity of chemical composition, with its resulting effect on physical characteristics, which gives rise to the problems which confront us.

Every year we are covering thousands of miles of streets and highways with asphaltic surfaces of various types. The performance of these surfaces is dependent, to a great extent, on the characteristics of the asphaltic binder. As a result of experience, particularly that of the past few years, there has developed a

realization that our knowledge of how performance is affected by the varying characteristics of these binder materials is woefully deficient

In the specifications for most engineering materials it is customary to include certain requirements which are designed to insure the practicability of using the materials in the intended manner. These may be termed construction requirements, in contrast to the requirements designed to insure satisfactory quality. For example, a construction requirement for crushed stone is that it shall be of a certain size or grading. Quality requirements for the same material may involve some measure of toughness, abrasive resistance or durability.

In the same manner there are certain construction requirements commonly found in the specifications for asphaltic materials. For example, we have the limitations on consistency, intended to provide a material which is neither too fluid nor too hard for the purpose. Also, for cut-back products, we have the distillation requirements whose purpose is to insure that the material will harden at a satisfactory rate. But the various requirements of this class are not, from the standpoint of this discussion, a matter of great concern. What we are concerned with are the quality requirements.

From the standpoint of quality, the essential characteristics of the asphaltic materials used in mixtures for road surfacing are ability to coat the particles of mineral aggregate, to adhere to them and bind them firmly together, and to resist disintegration due to the action of the elements. At first glance this may not seem to be an impressive statement but when one pauses to consider it in the light of our present knowledge, the needed research which it suggests is of staggering

proportions. In a brief discussion, such as this, one cannot hope to do more than suggest a few of the outstanding problems.

During the years of use of asphaltic road materials there have been developed numerous tests intended, by one means or another, to insure quality. Some of these tests attempt to measure certain qualities directly. Others are frankly identification tests intended to require the use of certain materials which previously have given satisfaction. A defect of the identification test is that, while it may require the use of certain satisfactory materials, it may exclude from use certain other materials which would be equally satisfactory. However, such tests are unscientific, to say the least, and it is unnecessary to discuss them further here except to point out that it is necessary to know which are, and which are not, identification tests. For some tests further research is required to determine this.

Certain tests which are intended to measure quality require further investigation to determine if they actually do this and, if so, to what extent. For example, serious questions may be raised regarding the time-honored ductility test. Obviously an asphaltic paving mixture should possess some ductility, but the discrepancies between ductility as determined by the standard test and the observed behavior of asphaltic pavements suggests the possibility that the test is not an accurate measure of the desired quality. In somewhat the same category are the requirements designed to control susceptibility to changes in temperature. There can be little argument on the proposition that an asphaltic road surface should not be too soft in hot weather nor too hard in cold weather.

However, there is evidence to indicate that the ordinary measures of susceptibility of the asphaltic material itself are not directly related to the susceptibility of the finished paving mixture. Moreover, susceptibility control as at present exercised may easily become no more than a means of identification. Therefore, its use requires a more thorough knowledge than appears to exist at present.

Discrepancies, such as have been mentioned, between test results and service behavior point to the probability, if not the certainty, that like some other materials, asphalt in thin films as it exists in a paving mixture does not exhibit the same properties as the relatively large masses of material involved in the standard laboratory tests. This suggests future research to correlate the characteristics of asphaltic materials, as measured by ordinary laboratory methods, with the properties of asphaltic paving mixtures. Work of this character, such as that already undertaken by Skidmore, Vokac, Rader and others, offers a fertile field for future investigation.

Asphaltic materials are refined from a wide variety of crude petroleums and in certain quarters there exists a decided preference for materials produced from the crudes of certain more or less restricted fields. Whether or not this preference is always entirely justified is at present a debatable question. Thus there is indicated the need for further research on sources of asphaltic materials to determine how the characteristics of the crude oils influence the quality of the finished products. For example, attention may be called to the presence of paraffin in some crudes and in the asphaltic materials produced from them. Two questions naturally arise. First, what is the maximum amount of paraffin which

may be permitted without danger of detrimental effect on quality? Second, may relatively high percentages of paraffin occurring in a crude oil be removed in the refinery process to produce an asphaltic product having desirable characteristics?

Closely associated with the questions relating to crude materials are the problems which arise in connection with the refinery processes to which they are subjected. Different methods of refining, applied to the same crude petroleum, may produce asphaltic residues of distinctly different characteristics. This is particularly true of the reduction processes which utilize steam and vacuum as compared with the cracking processes involving high pressures and temperatures. Serious questions are raised regarding the quality of *some* cracked products and there are some who question the use of *any* materials of this class. Experience has demonstrated that some cracked materials are of unsatisfactory quality. They deteriorate rapidly and become hard and lifeless with a complete lack of cementing properties. However, there is also evidence which indicates quite conclusively that not all cracked materials are of this character and that some may be entirely satisfactory for use in certain types of bituminous construction. Thus we have the products of one general class which may be either good or poor, depending on characteristics which we are unable to predetermine. In the absence of a method for measuring quality prior to use there is a general tendency to place all cracked products in a single category and discriminate against the whole group. Research which will correct this situation is of the utmost importance.

A high degree of durability, or resistance to weathering action, is one of the most important characteristics of a good

asphaltic road material. It is also a characteristic concerning which little, if anything, can be foretold from the methods of test now in use. Some research has been done in this field but much more is required before a definite answer can be obtained. A correct solution of this problem may be expected to go a long way toward answering related questions, such as those concerning the influence of refining methods.

Both experience and research have shown that the operation of heating, mixing and placing asphaltic paving mixtures alters the characteristics of the asphalt, some asphalts being altered more severely than others. This fact is recognized in certain recent specifications which attempt to control the asphaltic material furnished, and the manipulation to which it is subjected, by establishing minimum requirements which must be met by the asphalt extracted from the finished pavement. In principle, this procedure appears logical enough, although it introduces a practical difficulty by dividing the responsibility between the producer who furnishes the asphalt and the contractor who uses it. However, many facts must be ascertained before it can be used with complete assurance of success. First, we must know the true significance of the tests to which the extracted asphalt is subjected. Is a change in ductility or other property, as determined by the usual laboratory tests, truly indicative of a detrimental effect on quality? Second, knowing that all asphalts are changed to some extent by the heat and oxidation to which they are subjected during construction, it is necessary also to know to what extent such changes may be permitted without endangering the quality of the finished construction.

The results of a few tests recently made

in the laboratories of the Bureau of Public Roads illustrate the changes which may take place in asphaltic materials due to prolonged heating. Samples of six paving asphalts were subjected to the standard test for loss on heating for periods up to 100 hours and various properties of the residues measured. The original penetration of the samples at 77°F ranged from 52 to 96 and they all had a ductility at this temperature in excess of 110 centimeters. The volatilization loss after heating for 100 hours was small, the maximum loss for any sample being slightly more than one percent. However, the penetrations after 100 hours of heating ranged from 30 to 53 percent of the original penetrations and, with one exception, the ductilities showed an even greater change. One sample still retained a ductility in excess of 110 centimeters but none of the other five samples showed a ductility greater than 9 centimeters. Data such as these, considered independently, might be construed as evidence that this one asphalt was superior to the others. However, the experience of years with materials of similar character from the same sources would not support such a conclusion. This example merely illustrates that a simple solution of this and other problems need not be anticipated.

Thus far we have dealt mainly with the research which is needed to determine essential characteristics of the asphaltic materials themselves, without reference to the other materials with which they are used. It is necessary to go far beyond this and to study the inter-relation which exists between asphaltic products and the mineral aggregates with which, in road construction, they are combined. For example, the fact is known, though frequently overlooked, that variations in the surface character of the mineral aggregate

in a bituminous mixture may have a greater influence on stability than a considerable variation in the character of the asphaltic binder. The adhesion of bituminous films to aggregate particles, the resistance of bituminous films to water and the durability of the films under traffic, as these properties may be influenced by the character of the mineral aggregate, are subjects which should have intensive study. Surface chemistry, already applied with success to the study of soil stabilization, may be expected to play a major part in the solution of these problems.

In addition to the research required with respect to the use of bituminous materials in the types of construction which are more or less standard, we must also consider the new uses to which these materials may be put. Promising results have already been obtained in the utilization of liquid bituminous products in the stabilization of soils for base courses, and the future possibilities of this development can scarcely be estimated. Among

these possibilities is that of creating a market for petroleum products unsuited for other use in highway work. The work of Winterkorn has demonstrated the importance of surface chemistry as applied to research work in this field.

The needed research on asphaltic road materials has been described in a most general way but the details have been barely suggested. It is only when one considers these details, with all their ramifications, that the enormous complexity of the problem becomes apparent. For years it has been attacked at various points by numerous investigators working independently, but we are still far from any final solution. The problem is far too vast and complicated to yield to individual and uncoordinated effort. The combined effort of all those interested in the production and use of these materials is required if we are to expect results in any reasonable length of time. This research is not only needed. If we are to make the best use of a great natural resource, it is very urgently required.

DISCUSSION ON RESEARCH IN ASPHALTIC ROAD MATERIALS

MR R W CRUM, *Highway Research Board*. Mr Kelley with his usual clarity has described the situation that confronts us. From extensive correspondence I have conducted during the past year I have come to believe that in general we all agree with the situation as he has pictured it. Therefore, the problem before us is, what can be done? We have all been talking about the need for asphalt research but no one has done anything about it. We have come to a feeling that now is the time to mobilize for an attack on this problem which, as Mr Kelley pointed out, is an extremely large one. To do anything with it the cooperation of

the Bureau of Public Roads, producers of materials, State highway departments and colleges and universities must be enlisted. During the past year Mr Kelley, Mr Prevost Hubbard and I have been talking over this problem and trying to find a springboard from which to jump to make a start. As it is obvious that no agency could plan the complete program of research necessary to handle these problems right at once, we have felt the necessity for a year of exploratory work to define the problem and break this immense job down into work units. One thought has been that we might well start out by an examination of the record

Advice, suggestion and discussion of what to do about this problem are needed

PROF F C LANG, *Minnesota Department of Highways* At the present time, many engineers are decidedly of the opinion that the present specifications cannot be depended upon to secure asphaltic materials of a desired quality This lack of confidence in the specifications results in considerable confusion and misunderstanding A few of these are as follows.

- 1 Public officials dislike buying asphaltic materials on the open competitive basis, and, I might add, dislike not doing so
- 2 The variation in quality interferes with the development of better methods of construction This in itself restricts the use of the materials
- 3 In desperation engineers grasp at any new test methods that are at all promising Oftentimes the usefulness of these tests has not been corroborated by a number of laboratories or users
- 4 Identification tests are frequently used in purchasing asphaltic materials As Mr Kelley pointed out, it may exclude certain materials which would be satisfactory The local engineer may consider it safer to exclude some good materials rather than include one poor material which, on account of cost, would probably be the one used

Mr Kelley made the statement, "From the standpoint of quality, the essential characteristics of the asphaltic materials used in mixtures for road surfacing are ability to coat the particles of mineral aggregate, to adhere to them and bind them firmly together, and to resist disintegration due to the action of the elements "

Those are the essential characteristics—and I do not think that there can be much argument about them Therefore why not develop tests that will directly give us units for evaluating these essential characteristics? There will be many obstacles, but where have we arrived by the old method of indirectly attacking the problem? The present tests show one essential characteristic—consistency I have in mind tests on mixtures comparable to strength and freezing and thawing tests on concrete There can be no question but that the ideal test would tell us whether or not an asphaltic material from any unknown source or unknown manufacturing process is satisfactory for a given use I am convinced that for the average engineer, the source and manufacturing process are going to be unknown anyway It seems to me that it is much more logical for the engineer to have tests on the finished product than to try to test only the asphalt or to attempt to regulate the source and manufacturing methods The substance is chemically very complex, and I think experience has shown and will continue to show that plant chemists can comply with any specifications ever written and not always produce a good road material Let the chemist do what he wishes with the molecule so long as the finished product is all right

The need for a better way of evaluating asphaltic products is very great, and I believe there are enough capable men in the country to solve the problem if we could only arrange for some organized collective efforts, rather than sporadic individual activities I know of no better agency than the Highway Research Board

MR R A CATTELL, *Chief engineer, Petroleum and Natural Gas Division, U. S*

Bureau of Mines You have just listened to an admirable summary by Mr Kelley of the present situation with respect to the need for research on asphaltic road materials Mr Kelley's paper is evidence that he has been and is doing much constructive thinking on the subject A discussion of the several outstanding problems emphasized in his paper might be repetitious and accordingly I shall confine my remarks largely to observations that have been made by the Bureau of Mines during recent months, regarding this subject of asphaltic road materials, which in many respects parallel the thought of Mr Kelley

From the viewpoint of petroleum technology we are particularly impressed with the point stressed by Mr Kelley regarding the deficiency of authentic knowledge of quality requirements in their relation to source materials and refinery treatment

At present we can not speak on the basis of actual research in this field as we have had no opportunity to study the technology of manufacture of asphaltic products from petroleum, although we have been aware of its important place for some time This condition has been due mainly to the circumstance that until recently other problems have seemed to us to have priority in urgency requiring all of our available personnel and funds for their study However, the Petroleum and Natural Gas Division of the Bureau of Mines has been analyzing and studying crude petroleum for more than 20 years Using a method developed in our laboratories, we have analyzed more than 800 samples of crude petroleum from oil fields throughout the world, and in addition have made analyses and studies in greater detail of selected crude oils that are typical of certain rather large groups of oils Also we have studied a number of prob-

lems arising in the manufacture and use of petroleum products

These studies of crude oils and petroleum products have led us to the general conclusion that it is extremely hazardous to make dogmatic statements of what can be done or not done with a crude oil, merely on the basis of geographical distribution We have taken the position that the manufacture of good petroleum products depends to a larger degree upon the skill and integrity of the refiner and the efficacy of his refining equipment than upon the crude petroleum which is the raw material

At least one of these problems the Bureau has undertaken might have led us into a study of asphalt technology to a limited extent before this time, had it not been interrupted In 1930 we began a study of the black oils of the Rocky Mountain region at our petroleum field office on the campus of the University of Wyoming at Laramie In June, 1933 this study was terminated abruptly when we were forced to close the office due to the reductions in Congressional appropriations to the Bureau of Mines for oil and gas investigations

We have been enabled to reopen the Laramie office and now have six engineers at work in a building that was erected especially for our use by the University of Wyoming This building contains the usual equipment for research in petroleum Three of the six engineers now at Laramie were working there when the office was closed in 1933, and two others have been part of the force at our Bartlesville, Oklahoma petroleum experiment station for several years They are therefore well qualified to carry on the work from the point it had reached when the office was closed

After the unfinished part of the study

of thermo-decomposition (cracking) of black oils is completed, the way will be open to study other means of better utilization of these black oils. Manufacture of asphaltic products is an obvious outlet for the oils, provided investigation of their properties reveals that they or some of them are suitable for the purpose. We therefore expect to make such investigations along this line as our resources will permit.

As suggested, the Bureau has been cognizant for some time of the conditions in the asphalt industry, and has thought that essential properties of asphaltic materials would be a proper and worthwhile subject for study by the Petroleum and Natural Gas Division. It is our practice, before we decide definitely to start on a new problem, to seek advice and guidance from all types of interest in the problem, in order to answer the following questions.

- 1 Is the problem of real importance?
- 2 Is any one else working on the problem in the same way that we have in mind?
- 3 Is there a reasonable assurance that the problem can be solved in accordance with the need?
- 4 Are we in a position to contribute to its solution?

Pursuant to this policy, we made inquiry of our friends in the industry and in the Federal service, and have made the acquaintance of workers in this field whom we had previously not known personally. In all instances we found a very cordial spirit and an interest in the proposed research that was gratifying. There seems to be a substantial unanimity of opinion that essential properties of asphaltic materials is a real problem. We were confirmed in our opinion that a great deal of work is being done, but that

it is uncoordinated and consequently progress has been slow. We found also good agreement that the problem can be solved, but that it would be a long-time proposition. This is in accord with our views. Several suggestions were made as to ways in which we could contribute to the solution of the problem of determining the essential properties of asphaltic materials from petroleum.

Rather early in our inquiries, we became convinced that the problem is too large and complex for us or any other present organization to solve alone, and the concept of a cooperative research began to emerge. It was gratifying to learn that the Highway Research Board and others have been thinking and working along this line and that plans are being formulated for a comprehensive research program. This convinced us that we were on the right track.

We were not long in concluding that the study should be limited to paving asphalts from petroleum or "asphaltic materials" as Mr. Kelley uses the term in his paper to cover "the range of liquid, semi-solid and solid asphaltic products which are used in road construction." It seemed to us that a plan of cooperation should be and could be worked out with the participation of the Highway Research Board of the National Research Council, the Bureau of Public Roads of the Department of Agriculture, the Asphalt Institute, and the Bureau of Mines of the Department of the Interior, with provision for including interests that are not now identified with any of these organizations. The research should be guided, step by step, by a Steering Committee, so constituted that the committee could meet frequently, and with all interests represented by technical men with a real understanding of the various phases

of the problem. A successful outcome of the proposed research would go far to assist highway officials in purchasing asphaltic road materials so that they can have confidence in the wearing qualities of the completed highway, and to enable asphalt manufacturers to make products that they can feel assured will give satisfaction to the buyer

If the Bureau's appropriation for oil and gas work does not fall below its present level, we would be able to contribute substantially to such a cooperative research program by using some of our personnel and equipment at Laramie on technical studies relating to asphalts and their manufacture. This work would have technical supervision from our headquarters personnel in Washington and it is possible that it could be supplemented by studies at our larger experiment station at Bartlesville, Oklahoma

It is our hope, for the best interests of all concerned, that some such cooperative research program can be arranged, and we believe that with a reasonable degree of patience in awaiting results, returns will be realized out of all proportion to the costs involved

MR L C CAMPBELL, *New Mexico State Highway Department*. The writer is pleased to present the following as a brief summary of his convictions or tentative convictions arising from his approximate seven years association with the problem of asphaltic road materials

The object is to: (1) Establish a good practical standard of excellence for the several petroleum products used in highway surface construction. One that is neither so high nor so low that it defeats the end in view but one that, so far as its contribution to the finished product is concerned, assures the most enduring and

highest satisfaction for the expenditure throughout its "life time," (2) Write specifications that will insure to the maximum extent the attainment of that end.

To the writer's mind that gives rise to two basic essentials as follows: (1) The crude must be potentially capable of producing a good live enduring product (2) That product must not be injured during the process of refining

In connection with the crude it is, we believe, generally conceded that asphaltic and semi-asphaltic base oil (by whatever other names they may be called) are the only ones that are capable of producing a finished product regarded as practical and satisfactory (we might say "economically sound") for all but exceptional cases and conditions. Therefore we would say that examination of the crude proposed to be used for the purpose of determining whether it is of the essential base is first in order.

Thus the specifications would require the producer to furnish a sample of the crude for laboratory examination for this determination, all of which in our opinion is well within the bounds of feasibility.

In connection with injury during refining: This to all practical intents and purposes means cracking or (to avoid technicalities) "cracking to an injurious extent." This determination (Resistance to Oxidation Test, Kansas City Bulletin No 25, 1928 Revision, page 693) we believe is very simple, practical, easily understood and interpreted. We established, at least apparently, its dependability in spotting cracked or otherwise inferior products by much research experiment and have used it for seven years without controversy or at least without any one thus far being able to maintain any substantial objection to it.

When asphaltic and/or semi-asphaltic

base crude have been selected to the exclusion of inferior bases for road binding purposes, and the finished product insured against injury you have "quality," *endurance, weather resisting qualities, durability*. And that, as we understand the situation, is what the country is gunning for after a well developed case of sad experience arising from a large program of emergency relief construction.

Subject to all the grave perils of being in error and in sharp disagreement with men who should have forgotten more about this than the writer ever will know we state it as our conviction that the much sought after "quality and durability" may be obtained to the full extent it is possible to obtain it through the above "crude selection—non injury" means and that nothing more than substantiating evidences and manifestations of that obtained "quality" can at best possibly be secured from observation of and tests on samples taken out of finished surfaces from which it is impossible to identify, much less segregate and evaluate, a number of the contributing factors and still further impossible to break down one of the contributing factors (the asphaltic binder) into its component parts and spot what it is that makes it click or fail to click. We are confident that "laboratory investigation" (wherein all factors can be far better known and controlled) even to the extent of carefully building a series of experimental stretches and letting carefully controlled traffic pound out a verdict, is the general procedure through which the vital essentials can be best and most readily determined.

We offer this "crude selection—non injury" process as a simple and dependable means of obtaining the desired quality product for such consideration as it may merit and what value it may have

MR J E BOYD, *State Highway Board of Georgia*. Mr Kelley has pointed out that the necessity for research on Asphaltic Road Materials is generally admitted. May I add that if there is anyone who doubts the existence of such a necessity, the doubt can be attributed only to ignorance of the subject. The concrete examples of the necessity are no doubt more thoroughly appreciated by Mr Kelley than by most of us due to his position which affords an accurate perspective of the entire field of asphaltic road materials. Most of us are particularly concerned with a small corner of the entire field.

It is sadly true that there is no adequate quality requirement for asphaltic road materials, for which reason it has been, and yet is, necessary to inject into specifications certain descriptive requirements that may identify a product without indicating its value as a road building material. These tests are not entirely valueless for they describe, as nearly as present knowledge affords, some of the characteristics of asphalts that have previously proven satisfactory. That most of the tests in vogue are unscientific, and may exclude from use some satisfactory materials cannot be denied, however, we must still consider that these tests are all we yet have, and they with their imperfections must be retained until better tests are found.

Mr Kelley points out that satisfactory service records are not necessarily attributable to the characteristics specified for the asphaltic material, and suggests that in some cases success must have been obtained in spite of the test requirements. These observations emphasize the necessity for definite quality tests, tests that have long been sought by various individuals, tests that have not yet been de-

vised or proven adequate I was at one time brave enough or foolish enough, as you choose, to attempt to measure the adhesiveness of various asphalts to various types of aggregates I found so many factors affecting the tests that I drew no conclusions I made the general observation, however, that the cohesive strength of all asphalts tested was under all conditions less than the adhesive strength If this is a general phenomenon then why should we be concerned with adhesive strength? Cohesive strength was found to closely parallel ductility at a given temperature, for which reason, I concluded that after all the ductility test was the proper measure of quality Now Mr Kelley suggests that ductility is likely not a proper quality test The ductility requirement may not be an adequate requirement and it may exclude satisfactory materials if fixed too high but it is in my opinion, the nearest approach to a quality test that has yet been devised

Concerning weathering properties, the oxygen bomb may be used as in rubber tests to indicate expected life I feel that the problem is more than half finished in that the necessity is recognized and the attack is under way by an organized force that will not be satisfied until the answer is found

MR C M BASKIN, *Imperial Oil Co, Ltd* I certainly agree with Mr Kelley that present asphalt tests, passing as measures of quality are, at best only signs or marks of identification Even as such they merely denote that asphalt used today more or less resembles visually or otherwise what was used 30 years ago For an industry as important as bituminous road construction to be confined to and restricted by a few arbitrary signs is

hardly a desirable state Seeing that of late, invention of identification tests has become a favorite pastime, with technicians surpassing themselves in working out intricate methods how to restrict development of available raw materials, Mr Kelley's demand for some action along sound lines is, indeed, very timely

To start with, we must realize that, whatever work was done that could at all be classed as research, resulted in a considerable amount of scientific data, especially on analysis and make-up of bituminous materials The question arises as to why our research efforts, modest as these may have been, never crystallized into some definite control measures that would have a bearing on quality of material

For one thing, asphalt research has been too abstract in form and sadly out of touch with practical demands An investigator for instance, finds after considerable work, that a 60 penetration asphalt cement contains 30 per cent of oily constituents compared to a similar consistency asphalt with only 20 per cent of oily constituents, but exactly what bearing the oily constituents have on behavior of asphalt when combined with mineral matter is something that he hardly touched upon The main difficulty, as I see it, has been that asphalt research was carried on either by people who knew little of practical requirements and consequently did not know what to look for, or by individuals who, while knowing what is required, did all possible to tie these requirements up to some particular raw material rather than to a finished serviceable product

Thus, it would seem that before any definite organization is established, the first requisite is to have the proper combination of view points The research

chemist left to himself, is unfortunately lost in a maze of data of only academic value. The highway engineer is too concerned with immediate results and is generally impatient with experimentation. The refinery technician is usually under the constant pressure of having to convert residuals into asphalts or something that looks like asphalt.

In other words, any attempt to arrive at a solution to the problem of how to tell whether an asphalt is satisfactory or not, will have to be a combined effort on part of the research chemist, highway engineer and refinery technologist. The highway engineer must formulate what he requires, the chemist must analyze products in use with a view of determining what in the makeup of the asphalt, is responsible for desirable or undesirable behavior, and the refinery technologist can then see how asphalt of the right composition can best be produced. It will have to be a combination of individuals who are not only versed in their respective fields, but are sufficiently broad to have a fair understanding of either one.

Past experience, however, would indicate that a concerted move in the direction of a systematic investigation of as-

phalts will hardly come by invitation of individuals, each one likely to have different and conflicting interests. The purpose of such investigation is very clear and an organization dealing with it would necessarily have to be composed of individuals who are not distracted by anything else. At the moment, I would say that the Bureau of Public Roads should be in position to undertake an investigation of this sort, with the possible assistance of an advisory Committee chosen at large.

Again, I am very sceptical of anything of definite value resulting from the present unsystematic efforts by individual investigators working by themselves and for themselves. The problem can be briefly stated as—"What is quality in asphalt cement, how could this be quickly demonstrated in the laboratory, and what constituents of asphalt and characteristics of these constituents are responsible for certain behavior?" If this were properly defined and a definite organization set up to deal with it, it would not be long before the Refinery Technologist would devise ways and means how to produce uniformly and steadily what is required.