ENGINEERING

Roads Are Not all Asphalt

Tin Cans, Old Bottles, Iron, Salt, Molasses, and Even Diamonds and Jade Used in Modern Pavements

MOTORISTS who think of highways in terms of asphalt and concrete may be skeptical about driving on a road of cast iron, molasses, or old bottles. But the fact is that these and a fantastic variety of other materials are being tried in the construction of highways.

To the Russian town of Sverdlovsk should probably go the distinction of sponsoring the most ornamental highway pavement. Here a road was found containing crushed jade, topaz, green malachite and jasper. The Russian road was a costly mistake, but not so costly as the one at Kimberly, South Africa. First prize for extravagance is awarded that most expensive macadam road on record—a blue clay "studded" with diamonds, some as big as hazelnuts and worth, altogether, about five million dollars.

Quite conscious, on the other hand, has been the liberality of road builders in England, where thirty years ago a part of Buckingham Palace Road was surfaced with camphor wood, one of the most rare and beautiful types imported from the East Indies. In Piccadilly an eccentric highway enthusiast worked for many years on a pavement of boxwood, but before his luxury had been completed it had taken all his money.

Old Bottles

English experiment has revealed that glass roads made of old bottles and other glassware remelted and molded in blocks eight inches square will produce a surface strong enough to stand up under the heaviest traffic, even though the thickness of the glass is but an inch and a half. To prevent skidding, the surface of the blocks is serrated in a diamond pattern, and firm seating in the bituminous base course is attained by hollowing the under sides about an eighth of an inch. The use of bitumen between blocks is intended to minimize the impact from passing motor vehicles. In Czechoslovakia glass is powdered and mixed with cement for highway surfacing.

From Scotland, Italy and Australia come reports of rubber roads, some of which are made with tiles only eight-tenths of an inch thick, laid in a thin asphalt cushion on a stone base. Although some of these roads have proved too costly, it is hoped that the use of more latex with the rubber will result in greater economy and consequent extension of these pavements.

Cast iron roads have been used in London for some time, and results thus far indicate that these should have a practically "everlasting" service life. The iron is in the form of ribbed and perforated tiles a foot square, which interlock and are laid in a bituminous mixture applied hot and "squeegeed" over a concrete base. The joints are then grouted with the same material.

Iron Roads

Iron highways are said to be economical for heavily travelled routes, and are easily kept clean. Steel mesh roads, another of the metal types, are reported to have particular advantages for severe traffic conditions, the mesh for these surfaces being assembled on an undercushion of mastic asphalt, then filled to the top with the same material.

The salt roads belong to the class of so-called stabilized soil types. Benefit to the wearing-course is obtained by action of the salt on the soil particles, causing crystallization in the surface, moisture retention, and the shedding of excess water. Rock salt is the form most commonly used, although evaporated salt, as well as salt brine, give equally good results.

Molasses

The driver who has been stuck in the mud may find little comfort in the thought of a highway stabilized with molasses. Nevertheless, a molasses road fifty miles long is now in use in India, and owing to the proximity of sugar factories where large accumulations of waste molasses may be obtained, this material is especially cheap for road purposes.

Mixed with water, the molasses is spread out over the surface, which has been swept of all loose dust by means of coconut fiber brooms. After the

EXPERIMENTAL ROAD

At the Arlington, Va., experiment farm scientists of the U. S. Bureau of Public Roads have the full-size pavement shown above where all manner of different types of highway material can be put through rigid tests.

USING THE DIVINING ROD

U. S. Bureau of Public Roads engineers use the latest methods of geophysical prospecting to locate the depth of bed rock beneath road foundations and to find deposits of gravel and stone which might be useful in highway building.

molasses has soaked into the road a half hour, it is covered with coarse sand, and traffic allowed to pass over it. To prevent the molasses from being washed away by rain, the addition of burnt lime is now being experimented with in order to produce tri-calcium sucrate, which is insoluble in water. The use of a small quantity of charcoal powder is expected to quicken the setting action.

After a few weeks of use, a molasses road becomes thoroughly compacted by traffic, and the surface looks dark, as if it had been tarred or asphalted.

Another binder for roads has recently been developed from the raw liquid waste product of rayon and cellophane pulp manufacture. Its principal constituent is lignin, a glue-like natural cement. From experience in a number of states which have used this fluid either as a dust layer, soil binder or for macadam mixes, it is estimated that it may save a large part of the cost of maintaining gravels and surfacing secondary roads.

Volcanic Ash

Nature has been kind to some parts of Alaska. Highways of volcanic ash, extremely stable and long wearing, can be found in certain localities there.

Wood pulp has been used for highway surfacing in Tasmania, the pulp being mixed with bitumen, to which is added 10 per cent tar or oil. Disintegration of the pulp in the hot mixture produces the binder material.

Soil conditions below sea-level make road building in the Netherlands a difficult job. One method has been the use of reeds impregnated with creosote oil and woven with wire into mats. Because they contain a high percentage of silicic acid, the reeds are resistant to rot, and are intended as a waterproof mat between the unstable mud and the layer of bricks on the surface.

Cotton

Cotton in highway construction was first introduced in South Carolina, and at present there are several states experimenting with this material. The general method of procedure consists of treating the gravel base of the road with tar or asphalt, on which is laid the cotton fabric. This is placed longitudinally in wide strips. A penetration asphalt is then applied to the cotton, which is of open weave to permit a bond between the prime and cover coats of asphalt. The fabric is also made of soft-twisted yarn in order that sufficient bitumen may be absorbed to preserve it in the ground. Stone is used to cover the cotton, and after a light rolling the road is opened to traffic. Conclusive evidence of the benefits from cotton highways has not yet been found.

A similar process has been followed in the surfacing of Calcutta streets, where jute cloth has been spread beneath the wearing-course so that moisture from the surface is unable to percolate, the base thereby being kept intact. The jute cloth also serves to bind the wearing-course to the substratum.

Quite original was the road built many years ago in Monterey, Calif., for it is probably still the only whalebone pavement in the world. And yet due credit for originality, and possibly a sense of humor as well, must be granted a particularly enterprising concern in Liverpool, England. Taking a cue, perhaps, from what was seen traveling over the highways, it conceived the idea of a tin can road, melting and molding the tin in the form of paving blocks. The average motorist, however, is apt to feel that whereas such things as tin cans and molasses may go perfectly well together, neither one sounds very promising for a highway.

Modern highway research is no longer the hit-or-miss affair of the individual road contractor that it once was in the days when the American motorists raised their cry of "Get us out of the mud!"

The Highway Research Board of the National Research Council in Washington maintains a whole technical and office staff to do nothing but collect, coordinate and serve as a clearing house for the distribution of information on highway research in all its phases from finance and gasoline taxes, to road construction and the highway aspects of the traffic safety problem.

Just across the Potomac River, near Arlington Cemetery in Virginia, the U. S. Bureau of Public Roads maintains its Experiment Station which undertakes original research in road construction.

There a test section of experimental road is laid out where all new advances in road construction and the fundamental engineering of highway building are put through the most exhaustive tests which science can devise.

Modern road building is no longer a question of drawing a route on a map after engineers and surveyors have been over the proposed site.

Modern "Divining Rod"

The 20th century equivalent of the ancient "divining rod"—the geophysical electrical prospecting method—is now employed to study subsurface structure of the land underlying a future highway. This technique is of the same type as that used to find salt domes in the oil fields of Texas. If plans require that the road go through a swamp, engineers determine how deep it is to bedrock so that they can carefully estimate the amount of rock fill needed to bear the highway surface.

Then too, electrical prospecting can

foretell the hidden location of gravel and rock deposits which might provide a cheap and easily accessible source of this valuable road material.

Another way that modern research aids highway building is in the use of thermocouples to determine the temperatures inside the concrete after it has been poured and is setting to its final rock-like nature. Moreover, thermocouples tell how much a large slab of concrete in a highway will expand or contract in the temperature range from torrid mid-summer to frigid winter in the various climes of the nation.

The special, full-sized concrete road at the Arlington Experiment Farm of the U. S. Bureau of Public Roads contains many of these thermocouples.

Some magnitude of the research program on this special test section of highway is obtained from the knowledge that 65,000 measurements of slab expansion and contraction and 30,000 temperature measurements have been taken, as well as 30,000 strain determinations and 25,000 deflection observations.

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between ships and shore, aircraft and ground and directional signals upon which human lives depend can be seriously interfered with by "sky waves" of considerable intensity set up by the short wave diathermy and artificial fever devices now employed by many physicians.

Dr. H. B. Williams of New York City warns physicians of the nation through the *Journal of the American Medical Association* (Nov. 28) that they must take prompt steps to abate this nuisance. Otherwise, he declares, relief through legislation will be sought, with a possibility of undesirable restrictions being placed on the use of therapeutic machines.

The council on physical therapy of the American Medical Association is expected shortly to alter its requirements for acceptance of electrical equipment such as is known to have caused interference. Manufacturers will be asked to submit evidence that the construction and installation specifications are such as to prevent interference.

Even when not a menace, the physician's and surgeon's diathermy machine may be a nuisance, causing static in every radio receiving set that derives power from the same line, Dr. Williams points out.

The chief instance of radio interference from this cause came last winter when important activities of the Naval Research Laboratory at Washington, D. C., were subjected to interference so serious as to stop the work completely.

After great trouble and expense, the disturbance was eventually traced to a diathermy unit located in a hospital at Cambridge, Mass.

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CHEMISTRY

Pre-Shrunk Paint Helps Prevent Surface Weathering

"PRE-SHRUNK" paint has become a reality. Contrived with the help of soybeans and tung nuts, this latest product of industrial research in new farm crops has had two results. It has altered previous knowledge of how paint should be made and further bears promise of solving the problem of weathering in this commodity.

"Pre-shrunk" paint is another of those curious unforeseen accidental discoveries which give constant zest to the life of the research chemist. This one happened in the laboratory of a South Bend manufacturing plant where tung oil's possibilities as a "vehicle" for paint were under investigation.

For use in paint tung oil requires a delicate high temperature treatment. The process, however, is often marked by failure because if the heat goes too high the liquid will change to a solid within a matter of seconds. For thirty years chemists have known how to control that trouble so the tung oil can be used in varnish. But, until recently use of tung oil in paint has been limited.

How the trouble was overcome and pre-shrunk paint evolved was revealed by M. F. Taggert, director of research for the South Bend concern.

"After trying all practical mixtures of oil," Mr. Taggert stated, "we found that a mixture of 45 per cent soybean oil with 55 per cent tung oil was the best combination to prevent solidification in the high temperature treatment required to make the tung oil usable in paint.

"In one particular trial we started with 775 pounds of the oil mixture which is equivalent to 100 gallons. This was raised to the suitable temperature with no difficulty, but in measuring up we discovered that although our mixture still weighed 775 pounds we only had 97 gallons of the liquid. Somehow there had been a shrinkage of three gallons, this being indicated by an increase in specific gravity exactly equivalent to the seemingly missing portion.

"Inasmuch as raw oils shrink during weathering, this pre-shrinking of the soybean-tung oil combination contributes to a longer life of the paint."

This accidental discovery, Mr. Taggert continued, immediately caused the scrapping of all previous knowledge of how paint should be made. Another problem arose, however, involving the question of what type of pigments and in what proportion of those pigments the new oil combination would work best.

Using the new "vehicle" with its peculiar "pre-shrunk" property, the chemists then went to work on hundreds of paint formulae. One pigment at a time was at first used, then pairs of pigments, and so on through the gamut of available pigments until eventually the one formula was determined in which the "pre-shrunk" quality of the oil can be utilized to the best advantage.

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ARCHAEOLOGY

Pipe Played in Stone Age Found in Oldest City

WHAT is believed to be the oldest musical instrument known to man has been discovered at ancient Tepe Gawra, Mesopotamia, it was stated by Prof. Millar Burrows, Yale Divinity School, President of the American Schools of Oriental Research.

The instrument, part of a double pipe of bone, dates from the Chalcolithic Age, when man was shifting from the Stone Age to the Age of Bronze. Tepe Gawra, famed as the world's oldest known city, is being excavated by a joint expedition of the University of Pennsylvania Museum and the American Schools of Oriental Research, under direction of Prof. E. A. Speiser of the University of Pennsylvania.