Treatment of Asphalt from Heet Area Using the Residues of Basic Oils

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Abstract

Samples of asphalt from the heet area have been testes as to their physical properties (penetration points, softening point, specific gravity, solubility in carbon tetrachloride, weight loss on heating, flash point) before and after treatment with different percentage of residues of basic oils.

There results show that treatment with residues from extraction process could improve the physical properties of the asphalt considerably.

So the asphalt of the heet area the residue resulting from the basic oils treatment process can be used for the production of different grades of asphalt with certain properties identical with those of asphalt produces in the refineries.

As known that asphalt is a compositive material commonly used for construction of pavement, highways, and packing lots.

الخلاصة:

تم في هذا البحث قياس درجة الغرز، درجة الليونة، الوزن النوعين قابلية السحب، الذوبانية في رابع كلوريد الكاربون، الفقدان بالتسخين ودرجة الوميض لنماذج من الاسفلت الموجود في منطقة هيت (محافظة الانبار) قبل وبعد عملية معالجتها باستعمال نسب مختلفة من مخلفات عملية معاملة زيوت الاساس.

نتائج الفحوصات تبين وجود تغيير ايجابي واضح في مواصفات اسفلت هيت والمخلفات الناتجة من عملية معادلة زيوت الاساس لانتاج درجات مختلفة من الاسفلت الناتج من المصافي وكما هو معلوم فان الاسفلت يستعمل عادة في البناء وفي تبليط الطرق السريعة.

Introduction:

Asphalt, also known as Asphaltum, often is used as abbreviation for asphalt concrete and is most common variety of bitumen (also called mineral pitch). It is a compact, glassy, brittle, black, or brown mineral. It is highly viscous liquid or semisolid which is presents in most crude petroleum and in some the natural deposits. Asphalt is sometimes

confused with tar, coal or pitch, because the appearance is similar and substances may be used interchangeably in many industrial processes. Tar and pitch are obtained from the coal products that chemically and physically different [1, 2].

There are two main types:

- Straight-run asphalt or "asphalt cement"- used for construction of pavement and parking lots. It consists of asphalt binder and mineral aggregate mixed together then laid down in layers and compacted.
- Air-blown or oxidized asphalt It has a high softening point and is primarily used in roofing, pipe covering, and in other similar situations [3].

As specifications, asphalt can be separated from the other components in crude oil (such as naphtha, gasoline and diesel) by the process of fractional distillation, usually under vacuum conditions. A better separation can be achieved by further processing of the heavier fractions of the crude oil a de-asphlating unit which uses either propane or butane in a supercritical phase to dissolve the lighter molecules which are then separated. Further processing is possibly by "blowing" the products namely reacting with oxygen. This makes the product harder and more viscous.

Basic asphalt chemistry is a mixture of many chemical types. It is a chemical composition of asphalt that determines its properties in whatever end use that is chosen. This is because asphalt is made up of polar and non- polar compounds in complex associations .this interaction of polar compounds determines asphalt structure and mechanical properties.

The chemistry of the asphalt produced depends on two main parameters, the crude source and manufacturing process. The chemistry may be basically paraffinic, naphthenic (straight chains or rings) or aromatic. This will affect the asphalt properties and influences the method of its manufacture and applications. Crudes or classified as heavy, medium or light, depending on the level of the bituminous materials [4]

Mixture formulations and uses:

Mixing of asphalt and aggregate is accomplished in one of several ways:

Heat mix asphalt concrete (commonly abbreviated as HMAC or HMC) is produced by heating the asphalt binder to decrease its viscosity and dry the aggregate to remove moisture from it prior to mixing at 150°C for virgin asphalt, 165°C for polymer modified asphalt and at 95°C for asphalt cement. .Paving and compaction must be performed while the asphalt is sufficiently hot HMAC is most commonly used as highly traffic pavement such as high ways, racetracks and airfields.

- Warm mix asphalt **concrete (commonly abbreviated as** WMA or WAM) is produced adding either Zeolites, waxes, or asphalt emulsions to the mix. This

allows significantly lower mixing and laying temperature and results in lower consumption of fossil fuels, thus releasing less carbon dioxide, aerosols and vapor The usage of these additives may afford easier compaction and allow weathers paving or longer hauls.

- Cold mix asphalt concrete; is produced by estimating the asphalt in water (essentially soap prior to mixing with the aggregate). While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact. The emulsion will break after energy water evaporates and cold mix will, ideally, take on the properties of cold HMAC. Cold mix is commonly used as a patching materials and no lesser trafficked service road.
- Cut-back asphalt concrete: is produced by dissolving the binder in kerosene or other lighter fraction of petroleum prior to mixing with the aggregate. While in its dissolve state the asphalt is less viscous and the mix is easy to work and compact. After the mix is laid down the lighter fraction evaporates.
- Mastic asphalt concrete: or sheet asphalt is produced by heating hard grade blown bitumen (oxidation) in a green cooker (mixer) until it has become a viscous liquid after which the aggregate mix is then added [5, 6].
- Rolled asphalt concrete: The largest use of asphalt is for making concrete for road surfaces and account for approximately 80% of the consumed. Roofing shingles account for most of the remaining asphalt consumption. Other uses include cattle sprays, fence post treatments and water-proofing for fabrics. This kind contains around 5% added bitumen.
- Mastic asphalt: is kind of asphalt which differs from dense graded asphalt(asphalt concrete) in that it has a higher bitumen(binderl content, usually, around 7-10% of the whole aggregate mix.
- Asphalt emulsion: This kind involves mixing the asphalt with petroleum solvents at much lower temperatures, to form "Cut-backs" with reduced melting point or mixture with water to turn the asphalt into an emulsion. Asphalt emulsions contain up to 70% asphalt and typically less 1.5%

chemical additives. These two main kinds of emulsions are with different affinity for aggregates, cationic and anionic. Asphalt emulsions are used in wide variety of applications; chipseal and slurryseal [**7].**

Experimental Part

All tests have been carried out in the lab of Al-Dura Refinery. Samples have been brought from Heet area and were purified using standard filters BS52 according to the British specification [8].

Penetration point, softening point (R&B), specific gravidity, ductility test at 25 C, solubility in CCLa %w, loss on heating %w and flash point tests were measured before treatment with oil residue, then 5%, 10%, 15% of these oil

residues were added to the asphalt samples and the above physical properties were measured again and showed the results explained in the following:

1- Penetration Point: The sample were melted and cooled under controlled conditions. The penetration was measured with a penetro-meter by means of which a standard needle was applied to the sample under specific conditions. This standard was issued under the fixed designation IP-49, and this method was adapted as a joint ASTM-IP standard in 2007 [9]. This test method covers the determination of the penetration of semi:- solid and solid and solid bituminous material. The needles, containers and other conditions described in this test methods provide for the determination of penetrations up to 500. This test was applied for the asphalt before and after treatment with 5%, 10% and 15% residue oil and the results obtained were tabulated in the table No. 1.

2- Softening Point (ring and ball apparatus): Bituminous materials do not change from the solid state to the liquid state at any definite temperature, but gradually become softer and less viscous as the temp raises, for this reason, the determination of the softening point must be made by a fixed, arbitrary and closely defined method if the results obtained are to be comparable, so this method was intended for the determination of the softening point of asphalt, so the temperatures were measured at which the asphalt attains a particular degree of softness under specified conditions of test ,because the softening point is useful in the classification of asphalt as one element in establishing the uniformity of shipments or source of supply, and is indicative of the tendency of the material to flow at elevated temperatures encountered in service . The softening point was calculated according to the IP-58 [10].

3- Specific Gravidity: This standard is issued under the fixed designation ASTM-D1298; by the hydrometer method [11]. The measurements were carried out at 15 C for the asphalt from Heet area before and after treatment with residual oil and the specific gravities were determined and tabulated in table No. 1. For this purpose, the ratio of mass of a given volume of asphalt at 15 C to mass of an equal volume of pure water at the same temperature were obtained.

4- Ductility Test: This standard was issued under the fixed designation IP-32 at 25 C [12] and D113 [13], where the ductility of the asphalts was measured by the distance to which it will elongate before breaking when two ends of the briquet specimen of the material were pulled apart at a specified speed and at specific temperature. Unless otherwise specified the test should be made at a temperature of 25 + 0.5 C and with a speed of 5 cm/min + 0.5%. At other temperature the speed should be specified. The method by which ductility was tested where described in the same reference.

5- Solubility in CC14 %w: - The standard was issued under the fixed designation IP-47 [14] and ASTM designation D2042 by which the determination of the degree of solubility in Trichloroethylene or other solven0ts as CCL4 of the asphalt material having little or no mineral matter, so the sample was dissolved in the solvent and filtered through a layer of powered glass in a cintered crucible. The insoluble material was washed, dried and weighed.

6- Loss on heating %w :- The method covers the determination of the loss in mass on heating of oil and asphaltic compounds as hereinafter prescribed under the specific conditions,. the sample is heated at a temperature of 163 C for 5 hours in a ventilated oven, the weighted to determine the loss in weight, so about 50 gm of material spread out in a 55mm in diameter, was heated for 5 hours at 163 C and the percentage loss of mass determined along with a comparison before

& after, of any other characteristics. This test method provides only a relative measurement of the volatility of a material

under test conditions [16, 17, and 18].

7- Flash point test:- this test method is a dynamic method and depends on definite rate of temperature increases to control the precision of the test method. Its primary use is for viscous material having flash point of 79 C and above. Flash point values are a function of the apparatus used, and the test method and no general valid correlation can be guaranteed between results obtained by different test methods. This method was obtained by using C level and open cup apparatus [19,20] (manually and automatically) and the results obtained are tabulated in table 1.

Result and Discussion

As seen from table No. 1, the values of the penetration points, softening points, ductility, solubility in CCLa, weight loss and flash point for the samples of asphalt taken from Heet area before and after treatment by adding a different ratio of oil residues that were produced by furfural extraction methods. There are positive improvements in the value of penetration after treatment with different ratios of oil residues and according to the British and American Standards. Also there is a certain improvement in the softening point which is proportional with the improvement in the penetration points. The table shows that the positive improvement of the specific gravidity, Ductility, the solubility in CCLa, loss in weight and flash point for Heet asphalt after treatment. As it is known the oil residues obtained from the oil refineries have a low economical value. Using the residues, gained in big amounts in the refineries, for the treatment of the Heet asphalt is not only of big economical value, but has also a positive effect on the environments, as the evaporation of the volatile parts of the asphalt (which is prevented by the treatment with the oil residues) leads to a considerable environmental pollution.

Table (1)
The Physical properties measured for Asphalt before and after treatment process

Sample of Heet Asphalt	Pen. Point at 25C 100 mg. 5Sec. 0.1mm	Soft. Point (R&B)	Specific gravity 15 C	Ductility 25 gravity 15C	Sol. In CCL4%W	%w(max) 5HRS163	Flash point
Before treatment	0	>100	-	0	50	15	120
+15% residues	60	50	1.02	+104	99.6	0.40	238
+10% residues	44	56	1.0	+102	99.4	0.40	243
+5% residues	12	120	1.0	+6	99.1	0.10	245

References

1- John Shadely, acoustical analysis of New Jersey Turnpike. Widening project between Raritan and East Burnswick. Bolt Beranek and Newman, 1973.

2- Michael Hogan, Analysis of highway noise, Journal of soil, Air and water, Pollution, Springer Verlag. Publishing Netherlands, Vol.22, No.3/Sept, 1973.

3- Michael Hogan(2008) Mosro Greek,ed. By A.Barnham [1] (http://www.megalilhic.co.uk/article.php?sid=18502).

4- Barth, Edwin J. Asphalt: science and technology Gordon and Breach (1962). 15BN 0-677-00040-5.

5- Q.D. Hobson and W. Poni, Modern Petroleum Technology, Applied Science, Barring, Essex (1973).

6- الدكتور لطيف حميد علي، النفط... المنشأ، التركيب، والتكنولوجيا، دار الكتب للطباعة والنشر – جامعة الموصل ١٩٨٦.

7- IP standard for petroleum and its product, Part 1, 2,3ed (1963).

8- C. Michael Hogen (2008) Morro Creek, ed. By A. Burnham [1].

9- IP standard for petroleum and its product, Part 1 P49 (2007).

10- IP standard for petroleum and its product, Part 1 P645 (2007).

11- Annual Book of ASTM standard, vol. 23 P449 (1990).

12- IP standard for petroleum and its product, Part 1, P274 (1963).

13- Annual Book of ASTM standard Designation D-113-99 (1999).

14- IP standard, Part 1, P173 (1982).

15- Annual Book of ASTM standard Designation: D2042 (2007).

16- II' standard, Part 1, P169. (1963).

17- British Standards BS 2000 Part 45. (1982).

18- Highway and transportation officials Standard AASHTO no: T47. Designation: D6-95 (2000).

19- American Association state (AASHTO) No: T48 Designation D92-02b (2003).

20- IP Standard Designation 36/84 (1989).

ASTM= American Society for Testing and Materials.