Modification of Asphalt by Diols

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الخلاصة

تركزت الدراسة في استخدام مركبات الكحولات الثنائية (الاثلين كلايكول و ثنائي أثلين كلايكول فضلاً عن مزيج منهما) في تطوير الاسفلت الذي تم الحصول عليه من مصفى القيارة , و تم اضافة مركبات الكحولات الثنائية بنسبة 0.5−5% وزناً,

و اجريت بعد ذلك فحوصات المواصفات الريولوجية و التي شملت كل من درجة الليونة و الاستطالة بالاضافة الى النفاذية, بشكل عام لوحظ انخفاض في قيم درجات الليونة وارتفاع في قيم الاستطالة و النفاذية مع زيادة نسبة الكحولات الثنائية للنماذج الاسفلتية المطورة. كما لوحظ ان بحدود 3% من الكحولات الثنائية تمتزج تماماً مع أسفلت القيارة.

Abstract

The research aimed to study the effect of Diols on modification of an asphaltic materials which could be used as a binder for paving material obtained from Qaiyarah asphalt. 0.5-5 wt.% of Diols (ethylene glycol ,diethylene glycol &mixture of them) were used to modify Qaiyarah asphalt binder .The performance of modified asphalt was investigated by rheological properties of asphalt.

Generally, the rheological properties (softening point, penetration point & ductility) showed decreasing of softening point, increasing of penetration and ductility with increasing of Diols ratio .In another aspect about 3wt.% of Diols were dissolved in Qaiyarah asphalt molten.

Introduction. Asphalt is widely used as a binder in paving materials. Although 4-6 Wt. % of asphalt binder is used with hot mixed asphalt concrete mixture to improve pavement performance significantly. The most commonly observed types of distress in asphalt concrete pavements are rutting, fatigue cracking, low temperature cracking, aging, ravelling and stripping (1).

Asphalt was modified with selected polymers and the performance was evaluated for polymers modified asphalt PMA(2-5).Drozdova et al.,(6) modified asphalt by the addition of waste polypropylene and polyethylene, in the presence iron chloride as a catalyst. The result showed improve polymer-asphalt quality. In a recent publication Mohammed iqbal et al., (7)had studied the effect of ethylene ethyl acrylate and glycidyl methacrylate terpolymer,and ethylene butyl acrylate copolymer on asphalt modification.The conculsion showed the addition

of ethylene ethyl acrylate and ethylene butyl acrylate significantly increased the viscoelastic properties(Resilient modulus & Dynamic viscosity)and both of polymer asphalt modifier hardens due to aging at the same polymer concentration. Hussein et al.,(8)studied the influence of average molecure weight of low density poly ethylene and vinyl acetate content of ethyl vinyl acetate on the properties of polymer modified asphalt.It was found that ethyl vinyl acetate with low vinyl acetate content(19.5%) showed the best storage stability and improved viscoelastic behaviour of base asphalt binder,in addition the influence of M.wt. of low density poly ethylene on the properties of polymer modified asphalt. In another study, Yu.V.Pokonova and L.M.Mitrofanova(9) were modified asphalt by phosphazenes by treated with triphosphonitrile chloride and poly phosphonitrile chloride with and without Aluminum chloride as a catalyst.The asphalt modifier was investigated by rheological properties (softening point ,penetration and ductility),high degree of gross-linking. The asphalt composite did not separate in to fractions when the researcher has used poly phosphonitrile chloride in a higher concentration of Aluminum chloride. In another study(10) poly and disulphide were reacted with chlorinated Qaiyarah asphalt.The rheological properties was evaluated by measuring penetration, softening point,ductility as well as specific gravity, rheological properties improved in comparison with chlorinated asphalt. Some researchers introduced elementary sulfur in polymer modified asphalt and significant improvement in rheological properties was observed (11-13). In this research, modification of asphalt was carried out using Diols(ethylene glycol ,diethylene glycol ,and mixture of them). The reason of using this compounds, was aimed to reduce the viscosity of Qaiyarah asphalt(14). Evaluation of modified asphalt binder was investigated by rheological properties (softening point, penetration and ductility).

Preparation of samples:

100 gm of Qaiyarah asphalt was transferred to3-nick R Bf. The sample was heated until 90°c. A known quantity of Diols was mixed with molten asphalt. The temperature was raised until 180, 225, 180°c for ethylene glycol, diethylene glycol and mixture of them respectively .The time of heating about 2 hours.

Results & Discussion

Qaiyarah asphalt is formed from 63.8%, 10.7%, 16.1% & 9.4% of naphthenic – aromatic non polar , polar aromatic , neutral oil and residual respectively(10). Therefore Qaiyarah asphalt has a high viscosity so to allow the asphalt to be applied in cold environments, the asphalt was thermally treated with Diols.

Table 1 shows the effect of ethylene glycol on physical properties of asphalt treated at 180°C

Table 1 : physical properties of modified asphalt by Ethylene glycol

number of sample	Ratio of Ethylene glycol	Softening point (°C) (15)	Penetration mm (100gm.5sec.25 °C) (16)	Ductility cm.25°C (17)
* L.V.	0	55	42	67
1	0.5	53.5	45	71
2	1	53	47	78
3	2	51	47	73
4	3	46	53	75
5	4	46	51	82
6	5	46.5	54	78

***** Laboratory value of Physical properties of Qaiyarah asphalt**.**

The softening point was decreased significantly ,with the increasing of ethylene glycol but the penetration & ductility were increased in these experiments. The better properties was obtained by (4 wt. %) of ethylene glycol, in comparison to the asphalt obtained with no modifier ,this sample have a lower softening point(46 °C versus 55°C) was characterized by a higher penetration(53 versus 42) and a higher ductility (82 versus 67) .

The rheological characteristics of asphalt with diethylene glycol(Table 2) indicate increasing the ductility in samples 7,8, but when it used above 1 wt. % of diethylene glycol ratio, the ductility begun to decreasing, consequently increasing the elasticity of asphalt . The better sample of asphalt modifier by diethylene glycol is appear in sample 8.

Table 2 :Physical properties of modified asphalt by Diethylene glycol

Number of sample	Ratio Of Diethylene glycol	Softening point (°C)	Penetration mm (100gm. 5sec.25°C)	Ductility Cm.25°C
7	0.5	52	43	70
8	1	50	48	69
9	2	48	49	30
10	3	44	53	35
11	4	45	52	10
12	5	44	58	10

another aspect , (Table 3) shows the better properties in sampl 15 (2 wt. % of mixture ethylene glycol & diethylene glycol).

Table 3 :Physical properties of modified asphalt by mixture of Ethylene glycol & Diethylene glycol (1:1)

Number Of Sample	Ratio Of mixture " E.G & D.E.G. "	Softening point (°C)	Penetration mm (100gm.5sec.25°C)	Ductility Cm.25°C
13	0.5	54	45	65
14	1	52	45	69
15	2	46	52	76
16	3	46	56	19
17	4	45	56	11
18	5	46	60	15

Conclusions

Ethylene glycol ,diethylene glycol and mixture of them were used to modify Qaiyarah asphalt , the following conclusions are drown on the basis of this modification:

1- The addition of ethylene glycol significantly improved some of the rheological properties of asphalt modifier which it used in cold conditions, in comparison to diethylene glycol &mixture of them.

2-Durring the preperation of expermints, the researcher was noticed dissolving Diols 3 wt. % because hydroxyl groups in Diols conjugated by intermolecular hydrogen bonding with hydroxyl, carboxyl, amine & amide groups in chemical composition of asphalt.

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