

RESEARCH
ARTICLE**Properties of road bitumen after adding technical oil acid with amidoamine and imidazoline synthesized****Vaqif Abbasov**

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Email: vaqif_abbasov@hotmail.com**Doi Serial**<https://doi.org/10.56334/sei/8.6.79>**Keywords**

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Abstract

Amidoamines were synthesized using technical petroleum acid (TPA) and diethylenetriamines (DETA). These amidoamines were added in the amount of 0.5% and 1% to road bitumen. The quality indicators of the obtained bitumens were studied. It was found that the brittleness temperature of road bitumen is minus 180C, and after adding additives this indicator becomes 280C and 300C

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Introduction

Bitumen is a mixture of organic liquids that are highly viscous, black, sticky, entirely soluble in carbon disulfide, and composed primarily of highly condensed polycyclic aromatic hydrocarbons.

Naturally occurring or crude bitumen is a sticky, tar-like form of petroleum which is so thick and heavy that it must be heated or diluted before it will flow. At room temperature, it has a consistency much like cold molasses [1]. Refined bitumen is the residual (bottom) fraction obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with the highest boiling point, boiling at 525 °C (977 °F).

In British English, the word 'asphalt' refers to a mixture of mineral aggregate and bitumen (or tarmac in common parlance). The word 'tar' refers to the black viscous material obtained from the destructive distillation of coal and is chemically distinct from bitumen. In American English, bitumen is referred to as 'asphalt' or 'asphalt cement' in engineering jargon. In Australian English, bitumen is sometimes used as the generic term for road surfaces. In Canadian English, the word bitumen is used to refer to the vast Canadian deposits of extremely heavy crude oil [2], while asphalt is used for the oil refinery product used to pave roads and manufacture roof shingles.

Due to the 95% of roads covered in asphalt, it is the most widely recycled material in the U.S. by percentage and second only to concrete by tonnage (67.8 million tons of asphalt [3] to 140 million tons of concrete [4]).

According to an industry survey conducted by the Federal Highway Administration and the National Asphalt Pavement Association and released in 2011, more than 99% of the asphalt removed each year from road surfaces during widening and resurfacing projects is reused as part of new pavements, roadbeds, shoulders and embankments. When reclaimed asphalt pavement and shingles are reprocessed into new pavement mixtures, the liquid asphalt binder

in the recycled material is reactivated, reducing the need for virgin asphalt binder. Using reclaimed materials also reduces demands on aggregate resources. Warm-mix asphalt technologies allow asphalt pavements to be produced at lower temperatures, which means reduced energy demands, as well as lower emissions during production and paving [5]. The largest use of asphalt/bitumen is for making asphalt concrete for road surfaces and accounts for approximately 85% of the asphalt consumed in the United States. Asphalt concrete pavement material is commonly composed of 5% bitumen cement and 95% aggregates (stone, sand, and gravel). Due to its highly viscous nature, bitumen cement must be heated so it can be mixed with the aggregates at the asphalt mixing plant [6].

Most bitumens contain sulfur and several heavy metals such as nickel, vanadium, lead, chromium, mercury and also arsenic, selenium, and other toxic

elements. Bitumens can provide good preservation of plants and animal fossils. The primary use (70%) of asphalt/bitumen is in road construction, where it is used as the glue or binder mixed with aggregate particles to create asphalt concrete. Its other main uses are for bituminous waterproofing products, including production of roofing felt and for sealing flat roofs [7]. Bitumen can now be made from non-petroleum based renewable resources such as sugar, molasses and rice, corn and potato starches. Bitumen can also be made from waste material by fractional distillation of used motor oils, which is sometimes disposed by burning or dumping into landfills. Non-petroleum based bitumen binders can be made light-colored. Roads made with lighter-colored pitch absorb less heat from solar radiation, and become less hot than darker surfaces, reducing their contribution to the urban heat island effect [8].



At the present our research work deal with to improve bitumen properties. We took technical oil acid and diethylenetriamine as raw, because they are very cheap and have very good results. At the result of process of diethylenetriamine with acidic oil at 140 °C temperature obtained amidoamines are separated into two parts. Amidoamines which first part additives to bitumens, second part are being continued at 220 °C for 3-4 hours and become imidazoline.

Diethylenetriamine ChemSpider ID:

13835401 Molecular Formula: $C_4H_{13}N_3$

Average mass: 103.166 Da

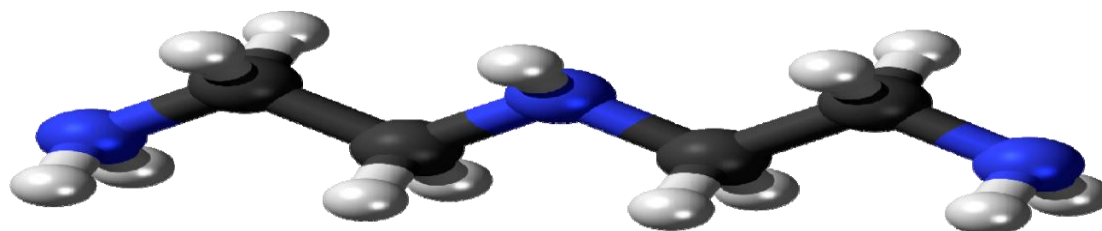
Monoisotopic mass: 103.110947 Da Systematic

name

N-(2-Aminoethyl)-1,2-ethanediamine

Ball-and-stick model of the diethylenetriamine molecule, an amine used as a ligand. Colour code:

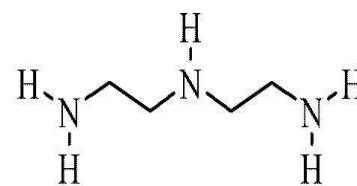
Carbon, C: black Hydrogen, H: white Nitrogen, N: blue



Naphthenic acid second raw material for the amidoamine and imidazoline is very cheap. Naphthenic acids (NAs) are water soluble weak acids, with the general chemical formula $C_nH_{2n+z}O_2$, where n is the carbon number, z is referred to as hydrogen deficiency, is a negative even integer and is the number of hydrogen atoms that are lost as the number of rings in

naphthenic acid increases. More than one isomer will exist for a given z

homolog and the molecular weights differ by 2 mass units (H₂) between z-series and by 14 mass units (CH₂) between n-series. The number of possible naphthenic acids, with the same molecular composition, are 134 with n ranging from 6 to 30 and the number of saturated rings ranging from 0 to 6. Fig.1 shows examples of the general



The quality properties of amidoamine and imidazoline synthesised additives have been learned and showed table 1.

Table 1. *Physical and chemical properties of additives*

Synthesized additives	Kinematic viscosity mm ² /s,100C	Mass of ash,%	Density 20°C-d ₄ kg/m ³	Freezing point, °C
Amidoamine TNT(280-340): DETA 1:1 molar ratio	36,13	0,02	1,001	+4
Amidoamine TNT(280-340): DETA 2:1 molar ratio	50,72	<0,002	0,9950	+5
Amidoamine TNT(280-340): DETA 3:1 molar ratio	27,84	<0,002	0,9731	+10
Imidazolin TNT(280-340):DETA 1:1 molar ratio	20,15	<0,002	0,986	+5
ImidazolinTNT(280-340): DETA 2:1 molar ratio	104,8	0,003	0,992	+7

The primary method for bitumen classification in the European standardisation framework is the penetration test at 25°C. The test involves the determination of bitumen consistency expressed as the distance that a standardised steel needle penetrates vertically into a bitumen sample at a specific temperature. The needle load is 100 g, and the loading time equals 5 seconds.

Table 2. *The quality properties of road bitumen after adding additives*

Synthesized additives	Softening point,°C		Penetration P ₂₅ ,0,1mm		Tension 13°C,sm		Brittleness,°C	
Road bitumen BND 60/70	48,5		58		10		-18	
Additives, %	0,5	1	0,5	1	0,5	1	0,5	1
Amidoamine TNT(280-340):DETA 1:1 molar ratio	50,5	51	58	52	12	8,8	-28	-20
Amidoamine TNT(280-340): DETA 2:1 molar ratio	48,5	49,5	60	61	12	15	-25	-27
Amidoamine TNT(280-340): DETA 3:1 molar ratio	49,5	49	51	53	13	12	-30	-28
Imidazolin TNT(280-340): DETA 1:1 molar ratio	49,5	50	55	56	10	12	-20	-23
Imidazolin TNT(280-340): DETA 2:1 molar ratio	48,5	49	59	60	11	10	-24	-25

The softening point is adopted as the average temperature at which both bitumen rings soften to the point that each ball, covered in bitumen and overcoming its resistance, travels a distance of 25.0 mm ± 0.4 mm.

The breaking point determines low-temperature bitumen properties and represents an approximate (conventional) lower limit of viscoelastic consistency. This has given rise to the partially adapted ductility test. It is called the elastic

recovery test. The test involves the determination of a conventional expression of bitumen elasticity being the distance between ends of a stretched and cut sample under pre-set conditions. A bitumen sample is stretched at a specified temperature (typically at 25°C or 10°C) at a constant speed of 50 mm/min., until its elongation reaches 200 mm.

References

1. "Oil Sands - Glossary". Oil Sands Royalty Guidelines. Government of Alberta. 2008. Retrieved 2008-02-02.
2. "What is Oil Sands". Alberta Energy. 2007. Retrieved 2008-01-10.
3. "National Asphalt Pavement Association - Recycling".⁴Jump up^
"The Waste Stream".
5. Jump up^ "New FHWA Survey Finds Asphalt Recycling Reaches 99 Percent". Asphalt Pavement Mix Production Survey: 2009–2010. National Asphalt Pavement Association. Retrieved 12 June 2012.
6. The Asphalt Paving Industry: A Global Perspective, 2nd Edition Lanham, Maryland, and Brussels: National Asphalt Pavement Association and European Asphalt Pavement Association. February 2011. ISBN 0-914313-06-1. Retrieved 27 September 2012.
7. Anja Sörensen and Bodo Wichert "Asphalt and Bitumen" in Ullmann's Encyclopedia of Industrial Chemistry Wiley-VCH, Weinheim, 2009. doi:10.1002/14356007.a03_169.pub2
8. Anja Sörensen and Bodo Wichert "Asphalt and Bitumen" in Ullmann's Encyclopedia of Industrial Chemistry Wiley-VCH, Weinheim, 2009. doi:10.1002/14356007.a03_169.pub2