WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Influence in Properties of Bituminous Composition when Mixed with Waste Toner

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ABSTRACT

In recent years, disposal of bulk quantity of waste toner generated from the manufacturing process, copying machines, and laser printers has been an immense issue. In this review, an endeavor has been made to conquer these issues by joining the waste toner in black-top blends in a legitimate proportion. This concentrate on intends to assess the impact of changing measurements (4%, 8%, 12%, 16% and 20%) of waste toner on functionality and mechanical properties of black-top combinations. Bitumen bond strength results show that the expansion of waste toner builds the bond strength of black-top covers. Rutting action are improved using toner modified bitumen. Waste toner which is a pollution menace can found useful in road constructing and thereby solving the problem to a certain extent.

1.INTRODUCTION

Bitumen is product of CRUDE OIL DISTILLATION, which acts as binding material holding aggregates intact. Due to the more demand of BITUMEN in the field of construction there is scarcity as this a non-renewable resource which has to preserved for future generation. To obtain good strength of a flexible pavement, optimum amount of bitumen has to be mixed. In order to minimize the usage of bitumen/asphalt, there is need to mix other materials (like carbon, plastic) which enhances its strength. One such material is WASTE TONER. More amount of toner reaches garbage every day from printing press, xerox shops etc. As significant tons of toner is being generated in India each year.This waste cannot be used in any of the other fields nor being recycled. Hence this is a serious problem for disposing toner in a eco-friendly way. As waste toner is rich in carbon content, it very well may be utilized in asphalt mix design to increase the strength of pavement.

Figure 1: BITUMEN & WASTE TONER

2.METHODOLOGY

The procured materials for the project work are:

- Coarse aggregates
- Waste toner
- Asphalt binder

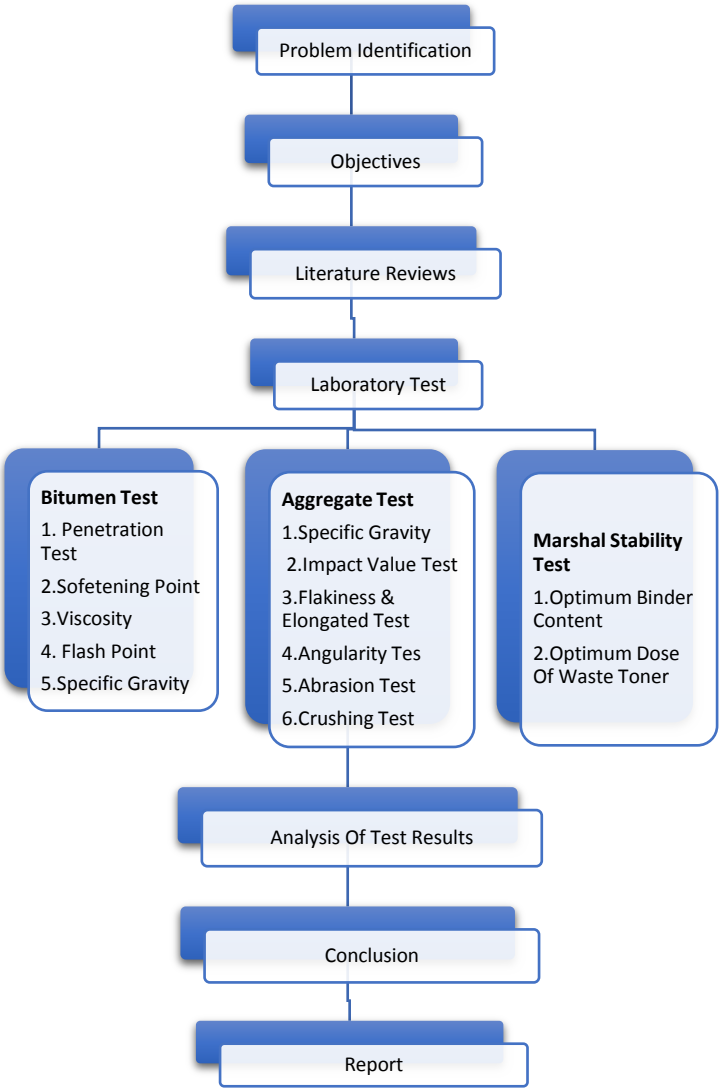


Figure 2: METHODOLOGY

3.LITERATURE REVIEW

3.1 Evaluation of workability and mechanical properties of asphalt binder and mixture modified with waste toner(2020) Jiandong Huang, G. Shiva Kumar, Yuantian Sun

To assess and comprehend the impacts of changing doses of waste toner on blend plan, usefulness, and mechanical properties.

Workability and viscosity results show that the expansion of waste toner diminishes siphoning capacity and functionality of black-top folio and combinations.

3.2 Investigating the effects on creep and fatigue behavior of asphalt mixtures with recycled materials as fillers(2020) Bara Wasfi Al-Mistarehi , Taisir S. Khadaywi, Ahlam Khaled Hussein

Research dissected the effect of five filler types on the jerk and weariness properties of black-top substantial combination and created numerical models to portray the connection between long-lasting disfigurements, stacking recurrence, and testing temperature for each kind of filler.

3.3 Study on utilising waste toner in asphalt cement(2013)
Taisir S. Khedaywi
The waste toner–asphalt binder has the potential of performing superiorly under cold climatic conditions as the penetration is increased with the expansion in percentage of waste toner by the volume of the binder.

3.4 Toner Modified Bitumen-A better method of disposal of spent Toner(2014)
Rema Devi M, Leni Stephen, Mini M I
The properties of Bitumen which mainly because rutting action are improved using Toner modified Bitumen.
All the waste spent Toner which is a pollution menace can find its use in road construction and thereby solving the problem of pollution to a certain extent.

3.5 Performance Evaluation of Using Waste Toner in Bituminous Material by Focusing on Aging and Moisture Susceptibility (2020)FereidoonMoghadasNejad,AliKhodaii,MohammadaliNotani
This study investigated the effect of waste toner as a cost-effective upgrade modifier on transient maturing and dampness opposition of black-top covers and blends.
The discoveries showed that altering fastener with low rates of waste toner improved the transient maturing obstruction.

3.6 Laboratory study to evaluate the effect of waste to night on dynamic creep of asphalt concrete mixtures (2018)Taisir S. Khedaywi
Resilient modulus, creep stiffness and accumulated strain were measured. Tests results show that resilient modulus & creep solidness expanding then diminishing with expanding % squander toner in the cover.
Tests result likewise show that collected strain diminishing with expanding % squander toner in the black-top substantial blend.

3.7 Properties of Printer Waste Toner Modified Bitumen(2016)
Chuang-min LI, Chao CHEN and Jian-sheng LIAO
The printer waste toner can improve the softening point of base bitumen about 30C-80C, accordingly, not only work on the high temperature stability of bitumen mixture, reduces rutting, but also maintain the low temperature anti-cracking performance of bitumen and bituminous mixture & show good social, monetary and ecological protection benefits.

3.8 Properties of Printer Waste Toner Modified Bitumen(2016)
Chuang-min LI, Chao CHEN and Jian-sheng LIAO
The outcomes show that the PWT can improve the softening point on the base bitumen about 3-8 degree Celsius, accordingly, not only improve the high temperature stability of bituminous mixtures, reduce rutting, but also maintain the low temperature anti-cracking performance of bitumen protection and bituminous mixtures and show the good social, monetary and natural advantages. This technology overcomes the technical problem the low temperature execution is sorry to be reduced when the high temperature execution is improved, which is posed by only adding the PWT(printer waste toner) to the base bitumen.

3.9 Study of Rheological and Creep Recovery Properties of Asphalt Binder Modified with Waste Toner(2020)
Burhan Showkat; S. N. Suresha, M.ASCE; and NingappaAkhandappagol
In this review, the degradation of fatigue resistance was observed. Ace bends demonstrated an upgrade in complex shear modulus (jGj) and decrease in stage point (δ) at low frequencies because of consolidation of WT. Nonetheless, at higher frequencies, intermingling of the bends was noticed. 12 MSCR investigation demonstrated that WT expansion upgraded percent recuperation (R) and diminished nonrecoverable killjoy consistence (Jnr).Overall, the expansion of WT was seen to prompt changes in the rheological conduct of AC30 fastener and a superior protection from rutting at high temperature.

3.10 Toner-modified asphalt demonstration projects(2004)
Yetkin Yildirim, Darren Hazlett, Rebecca Davio
The performance-grade (PG) properties of the toner-modified asphalt binders used in each test section varied according to the amount of polymers in the toner. Goals of the exploration included deciding the toner levels expected to show up at a given PG, just as a superior comprehension of the impact of toner level on the PG properties of a binder.Test results demonstrate that the solidness of the mix increments at all temperatures as the level of the toner content present increments. This solidifying impact is more articulated when the degree of toner content is at higher levels.Results likewise show that 2 h of mixing time is adequate to accomplish a homogeneous toner-black-top blend.

3.11 Utilization of Industrial Waste in the Construction of Flexible Pavement by Marshall Method(2020)
Mohammed Nayab, Mohammed Shahabuddin, Nazeer Patel, Priyanka Sheshappanava, Shahaji Patil
The study aim to give a significantexpression on the utilization of impact heater slag which is an industrial waste by product in the construction of pavement.

3.12 Challenges and Emerging Trends in Toner Waste Recycling(2021)
Meera Parthasarathi
Toner squander is one of the major electronic waste materials posing serious environmental threat and health hazards. Worldwide, somewhere around 20-30% of toner squander is reused, while the leftover rate is unloaded in landfills. Recycling choices are restricted because of the attractively designed solidness of toners, credited to a confounded arrangement of synthetic substances, carbon dark, and plastic particles, which thusly makes basic difficulties in recycling. The World Health Organization has characterized toner squander as class 2B cancer-causing agent because of its potential wellbeing hazard. In this survey, the current difficulties in toner squander reusing are examined according to the point of view of natural, wellbeing, and practicality viewpoints. In equal, the difficulties have been opening up elective methodologies to reuse toner squanders.

3.13 Performance Characteristics of Asphalt Binders and Mixtures Modified by Waste Toner
MANSOUR SOLAIMANIAN, THOMAS W. KENNEDY, AND RAKESH TRIPATHI
Consistently, a gigantic measure of toner is created for copiers and printers by toner producing organizations all through the United States.Some of this toner doesn't meet quality particulars and turns into a misuse of the assembling system. This waste and the burned through toner from copiers and printer cartridges are unloaded in landfills for absence of a superior approach to using them. 1 A helpful examination project was attempted by Texas Department of Transportation and the University of Texas to explore the achievability and likely advantages of using waste toner in hot blend black-top concrete.The research program included acquisition of various different waste toners, mixing them with black-top concrete at various proportions, and assessing fastener and combination properties. The results showed that as how much waste toner in the mix expands, the firmness and consistency of the altered folio increase. The combination investigation additionally demonstrates higher strength and solidness for toner-adjusted black-top cement contrasted and unmodified mixtures.The toner-changed cover is relied upon to perform sufficiently in regions where extremely durable disfigurement is of extraordinary concern and some expansion in low-temperature solidness isn't viewed as representing any breaking problems. It was observed that a PG6428 black-top will grade as PG70-22 with the option of 10% waste toner.

3.14 Rheological properties of bituminous binder modified with recycledwaste toner.
Jiandong Huang a, Xin Li, G. Shiva Kumar, YihaoDeng ,Minghui Gong , Niya Dong
Leftover waste toner (WT), which is richly creating with current industry, is a potential green asset that can be utilized as a black-top modifier for better engineering performance and cost-saving. This study is led to completely assess the attainability of involving WT as a black-top modifier thinking about different rheological properties of the adjusted folio. 9 Four distinct WT adjusted black-top are ready (with WT substance of 3%, 6%, 9%, and 12%).The properties of the altered fastener were researched through a progression of rheological tests including the customary folio determination tests (entrance, mellowing point, malleability, and glimmer point), multiple stress creep recovery(MSCR), 4 and Bending Beam Rheometer (BBR) tests. Testing results showed that the consolidation of WT can work on the rheological properties of the black-top covers at low and high temperatures no matter what the WT substance. 7 Besides, WT was shown a positive effect on break and holding performances.It is noticed that black-top covers containing up to 12% of WT had a huge enhancement for high-temperature, moderate temperature break, low-temperature breaking, and dampness awareness properties.In the end, the current exploration shows the lingering WT as a worth added modifier is a promising arrangement with both ecological and designing benefits.

3.15 USAGE OF WASTE MATERIALS IN PAVEMENT CONSTRUCTION WITH REPLACEMENT OF CONVENTIONAL MATERIALS (2020)
Sravanth B Sambaturu, Surendra Y.L,T.Nagaseshu Babu, K. Hemantha Raja,SS. Asadi
We can supplant these waste materials that of utilizing LDPE and old obliterate substantial design as the substitution in customary materials utilized in development of asphalt .
The polymer can be shaped by a wide assortment of thermoplastic handling strategies and in especially helpful where dampness opposition and minimal expense are required..

SAMPLE PREPARATION

Combination Designs were performed utilizing the Marshall strategy by getting ready and compacting tests with Bitumen content differed in 0.5% additions as per ASTM Test Method for Resistance to Plastic Flow of bituminous Mixtures Using Marshall Apparatus. Grade 60/70 Bitumen folio. Examples were compacted with 75 blows on each side. Three samples were made for each Bitumen content. The ideal Bitumen content was picked as the Bitumen content that delivered average of- 4% air voids, maximum stability and maximum bulk density. Further, two sorts of void were determined for the compacted tests: the void in mineral total (VMA). After determining the optimum binder content, three samples were prepared for each composition of waste toner (4%, 8%, 12%,16%, 20%).

RESULTS AND DISCUSSIONS

1. TESTS ON AGGREGATES

Tests that are taken for the examination of the development of asphalt are given in beneath table 1 with correlation of standard satisfactory qualities as per their specific code determined.

Table 1 : TESTS ON AGGREGATE

SLNO	TESTS	RESULTS	PERMISSIBLE VALUE	IS CODE
1	AGGREGATES CRUSHING VALUE	26%	30%	IS:2386(PART-Ⅳ)
2	IMPACT VALUE	21%	30%	IS:2386(PART-Ⅳ)
3	SPECIFIC GRAVITY	2.65	2.5-3	IS:2386(PART-Ⅲ)
4	WATER ABSORBTION	0.15	2%	IS:2386(PART-Ⅲ)
5	LOS ANGELES ABRASION TEST	30%	35%	IS:2386(PART-Ⅳ)
6	FLAKINESS INDEX	12.69%	-	IS:2386(PART-Ⅰ)
7	ELONGATED INDEX	5.74%	-	IS:2386(PART-Ⅰ)

2. TESTS ON BITUMEN

Tests that are taken for the examination of the development of asphalt are given in beneath table 2 with correlation of standard satisfactory qualities as per their specific code determined.

Table 2: TESTS ON BITUMEN

SL NO	TESTS	RESULTS	PERMISSIBLE VALUE	IS CODE
1	RING & BALL TEST (SOFTENING PONIT)	55˚C	56˚C	IS:1205-1978
2	PENETRATION TEST	6.5mm	6.0-7.0mm	IS:1203-1978
3	FLASH & FIRE POINT TEST	320˚C (FLASH) 340˚C (FIRE)	>175˚C	IS:1209-1978
4	VISCOSITY TEST	8 seconds	-	IS:1206-1978
5	SPECIFIC GRAVITY TEST	1.025	0.97-1.02	IS:1202-1978

3. MARSHAL METHOD OF MIX DESIGN

The mix design should aim at an economical blend, with proper gradation of aggregates and adequate proportion of bitumen so as to fulfil the desired properties of mix.

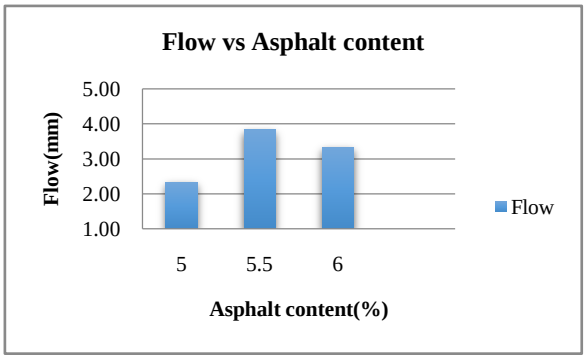
Table 3: AGGREGATE GRADATION FOR BC-GRADE 2

Sieves (mm)	Cumulative Percentage Passing (MORTH 2013)	Gradation Used For The Current Investigation
19	100	100
13.2	90-100	95
9.5	70-88	79
4.75	53-71	62
2.36	42-58	50
1.18	34-48	41
0.60	26-38	32
0.30	18-28	33
0.15	12-20	16
0.075	4-10	7

4. DETERMINATION OF OPTIMUM BINDER CONTENT

Table 4: MARSHAL PROPERTIESOF SPECIMEN OF BITUMEN

Bitumen By Weight Of Mix (%)	Avg. Marshal Stability (kN)	Flow (mm)	Bulk Density (kg/m3)	VMA (%)	VFA (%)	Air Voids (%)
5	17.030	2.33	2248	15.360	71.742	4.340
5.5	19.685	3.83	2265	15.830	77.151	3.617
6	16.884	3.33	2280	16.390	81.827	2.979



Flow vs Asphalt content

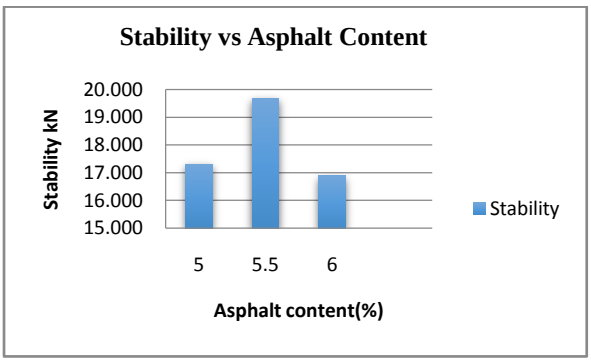


Figure 3: STABILITY VS ASPHALT CONTENT

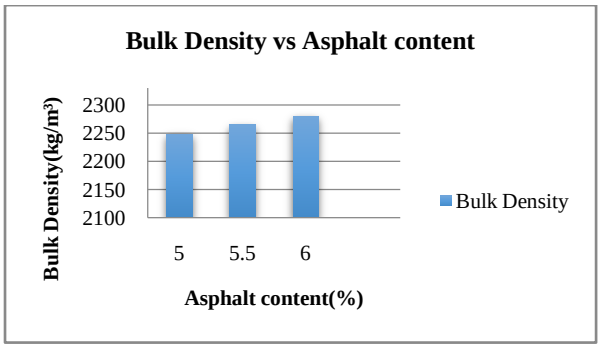
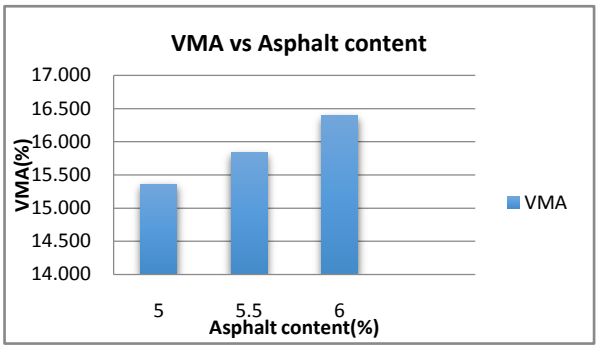


Figure 4: BULK DENSITY VS ASPHALT CONTENT



VMA VS ASPHALT CONTENT

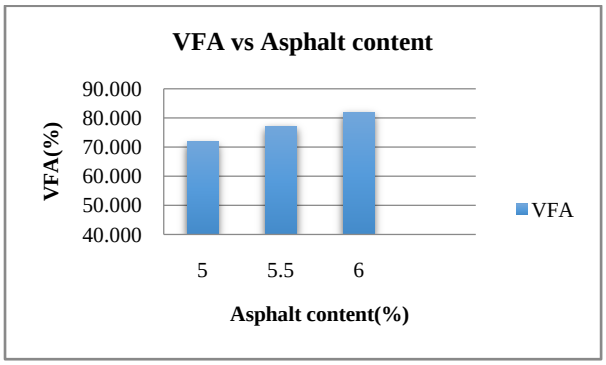


Figure 5: VFA VS ASPHALT CONTENT

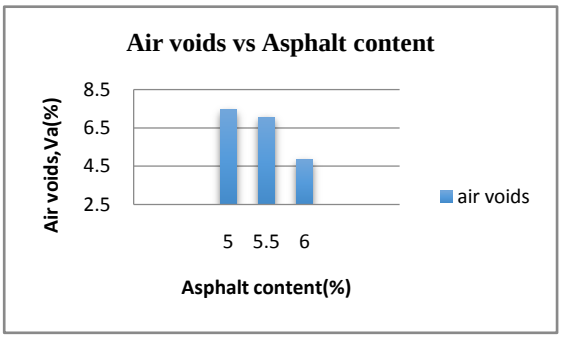


Figure 6: AIR VOIDS VS ASPHALT CONTENT

Determining Optimum Binder Content:

The ideal bitumen content is determined by taking the normal of the accompanying bitumen contents found from the individual charts.

- Bitumen content comparing to most extreme stability
- Bitumen content comparing to most extreme bulk density
- Bitumen content comparing to the 4% of air voids.

The optimum binder content determined as- 5.5%

With this ideal bitumen content the different properties of toner modified bituminous blends were tried for various dosage of waste toner content.

WTC	AV	VMA	VFB	BULK DENSITY	STABILITY	FLOW
4	3.135	15.703	80.035	2330.836454	15.565	3.750
8	2.769	15.386	82.003	2339.646465	19.814	4.500
12	2.555	15.198	83.192	2344.806008	22.048	5.670
16	1.515	14.294	89.401	2369.818653	25.271	6.270
20	1.338	14.206	90.581	2337.4613	16.188	6.470

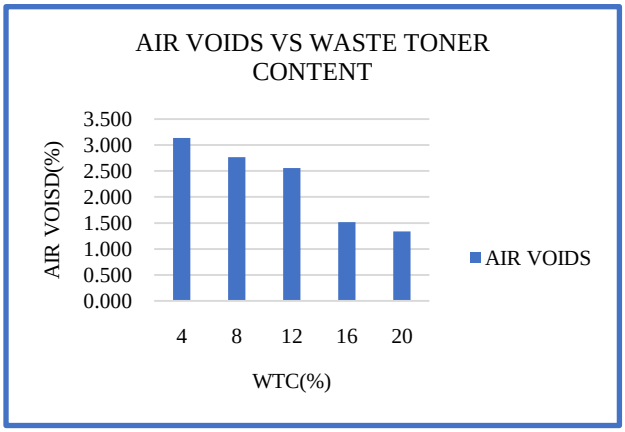
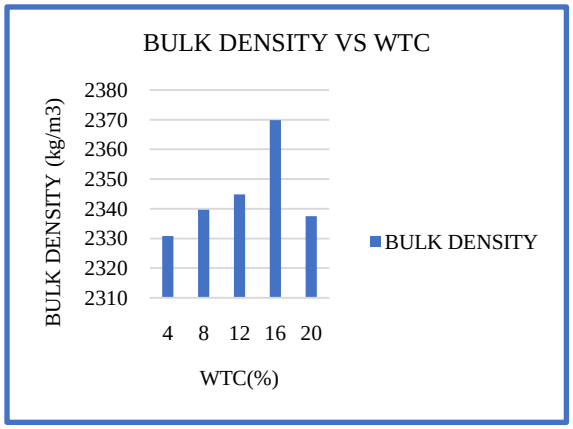


Figure 6: AIR VOIDS VS WASTE TONER CONTENT



BULK DENSITY VS WTC

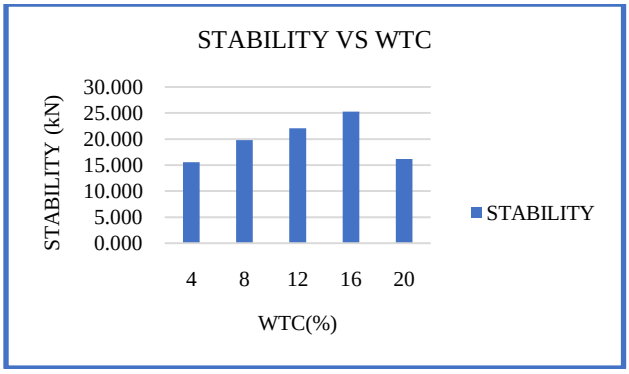
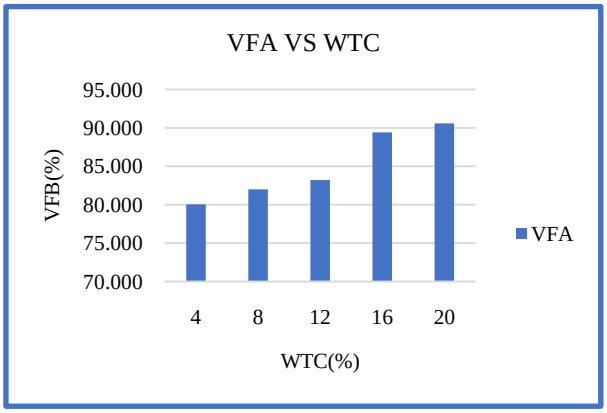
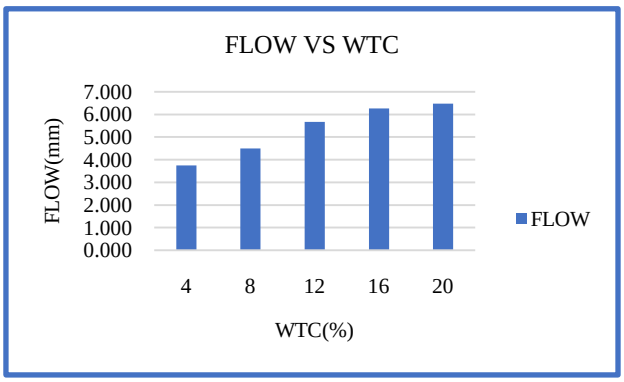
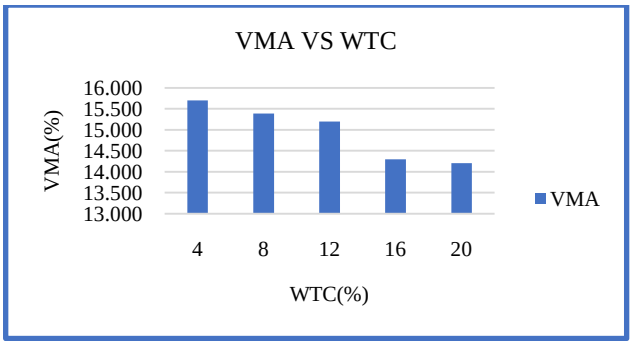


Figure 7: **STABILITY VS WTC**





FLOW VS WTC



VFA VS WTC

CONCLUSION

- Optimum binder content obtained as 5.5%.
- Considerable increase in marshal stability value obtained at 16% toner.
- Over all the waste burned through Toner which is a contamination danger can track down its utilization in street development and subsequently taking care of the issue of contamination partially.

REFERENCES

[1] G. Shiva Kumar, Jiandong Huang Yuantian Sun Evaluation Of Workability And Mechanical Properties Of Asphalt Binder And Mixture Modified With Waste Toner Construction and building materials

[2] Taisir S. Khedaywi Study OnUtilising Waste Toner In Asphalt Cement Road Materials And Pavement Design

[3]BaraWasfi Al-Mistarehi , Taisir S. Khadaywi, Ahlam Khaled Hussein, Investigating The Effects On Creep And Fatigue Behavior Of Asphalt Mixtures With Recycled Materials As Fillers

[4] Rema Devi M, Leni Stephen, Mini M I, Toner Modified Bitumen-A Better Method Of Disposal Of Spent Toner International Journal Of Engineering Research And Development

[5] Mohammad Ali Notani, Pouria Hajikarimi, Ph.D.,FereidoonMoghadasNejad, Ph.D., Ali Khodaii, Ph.D., Performance Evaluation Of Using Waste
Toner In Bituminous Material By Focusing On Aging And Moisture Susceptibility Article In Journal Of Materials In Civil Engineering

[6] Shahaji Patil, Mohammed Nayab, Mohammed Shahabuddin, Nazeer Patil, Priyanka ,Sheshappanava, Utilization Of Industrial Waste In The Construction Of Flexible Pavement By Marshall method, International Journal Of Scientific Research And Engineering Development

[7] Taisir S Khedawayi, Laboratory Study To Evaluate The Effect Of Waste Toner On Dynamic Creep Of Asphalt Concrete Mixtures Jordan Journal Of Civil Engineering

[8] Chuang-Min L I, Chao CHEN, Jian-Sheng LIAO Properties Of Printer Waste Toner Modified Bitumen

[9] Asfak I Patel, Ishitaben P Patel, Mehulsinh M Khengar, Seyalkumar P Patel Study On Warm Mix Design Of Bituminous Mixes (VG-30) International Research Journal Of Engineering And Technology

[10] Sravanth B Sambaturu, Surendra Y L, T Nagasehu Babu, K Hemanth Raja, S SAsadhi Usage Of Waste Materials In Pavement Construction With Replacement Of conventional materials International Journal Of Civil Engineering And Technology