The Iraqi Journal For Mechanical And Material Engineering, Vol.9, No.3, 2009

Design and Prepared of a New Rubber Composite for Absorption of Vibration in Electrical Generator

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Abstract

various vibration materials are available as structure use in equipment insulation. Rubber mounting type is a wide use as machine damping material in electrical generator . Rubber mounting characteristic are improved with thermoplastic addition. In the present paper an investigation of LDPE percentage on the different types of rubber matrix (IIR, SBR/Reclaim) to prepare the composite mounting and comparison these mountings with the prepared blend (SBR:NR)mountings. The works is achieved by using TM16 universal vibration apparatus with modifying the viscous damper into rubber damper and Wallace R-2 Dunlop Triposometer.

The results show, increasing the damping ratio (ζ) and logarithmic Decrement (Δ) with increasing of LDPE percentage of (0-10) (pphr.), and decreasing of decrement of trasmissiblly ratio(T) ,also show reducing of these criteria (ζ,Δ) above 10 (pphr),also can be concluded the best damping characteristics are founded in the SBR/Reclaim with 10% of LDPE type.

$$T = \left\{\left[1+(2\zeta r)^2\right]/\left[(1-r^2)^2+(2\zeta r)^2\right]\right\}^{1/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where ζ is damping ratio and r is the ratio of the excitation frequency to the natural frequency of the spring mass system, where the damping relates to the dissipation of energy. The increased damping results in faster decay of unforced vibrations and reduced amplitude of resonance of structure subject to steady excitations{1,2]. But the ratio of the energy dissipated per cycle to the energy present in the system is called the specific damping capacity Ψ. The loss factor η is often used to specific material damping and relation ship between these quantities are[1]:

$$\eta = (\psi/2\pi) = 2\zeta \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

There are a numerous researcher about rubber damping are :Ikuo Tak shita and et al., [4] in their study development or Detachable surface damper to stopping motors: NBR is selected of different suitable types of rubber material (NBR, IIR, CR), for reducing a wide range of vibrations and noise and providing an extension range of hardness.

Masamori Hanska [5] develops of magnetic rubber damper with a constraining layer MRDC (Zinc – Plated steel). The magnetic rubber layer is made of butyl rubber with added ferrite powder (particle size of 5 - 10 μm) for magnetization.

C.M.Richards and R. Singh[6] ,in their paper and experimental and analytical characteristics is applied to model three different types of rubber isolators .

Laszlo Molnzar and Antal Huba [7], in their paper two methods to define the dynamic properties of silicon rubbers .Firstly the classical dynamic mechanic analysis's [BMA] is demonstrated than direct measurement is shown to determine the frequency dependent dynamic characteristics data , their Conclusion the direct measurement the more reliable.

Vivioan Dias [8] in his work show urethane and thermoplastic material whose high internal damping characteristics.

In the present work an investigation of LDPE percentage on the different types of rubber matrix (IIR, SBR/Reclaim) to prepare rubber composite mounting for absorption of vibration in electrical generator and comparison these mountings with the prepared blend (SBR:NR)mounting .

2. Experimental :

A. samples preparation :in this work different types of modified rubber are prepared are:

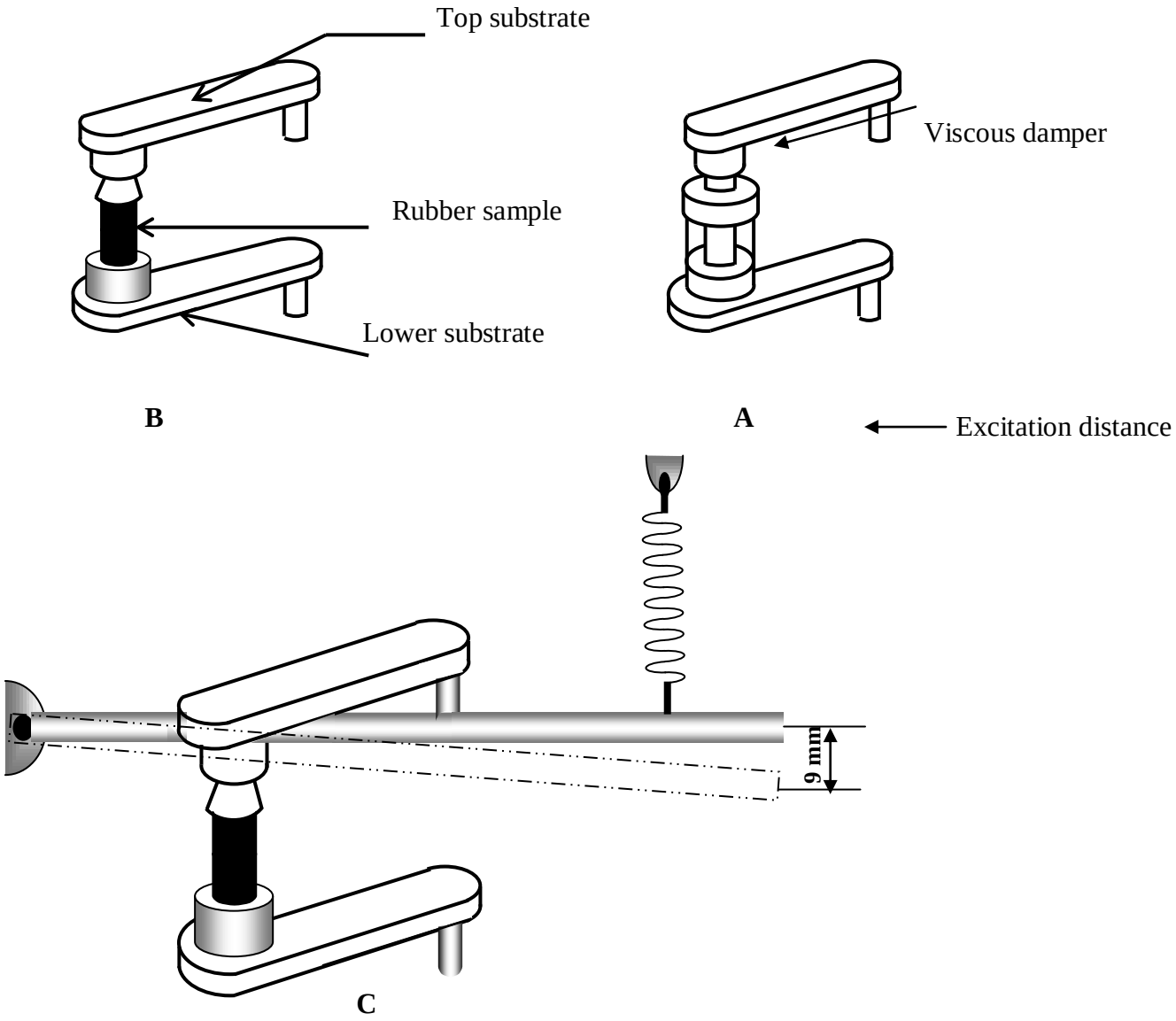
1. samples of SBR with varying LDPE percentage (0-20) pphr.
2. Samples of IIR with varying LDPE percentage (0-20) pphr.
3. Samples of SBR/ Reclaim with varying LDPE percentage (0-20) pphr.

composition of SBR/reclaim ,IIR/ reclaim and LDPE are shown in table (1A,B,C).

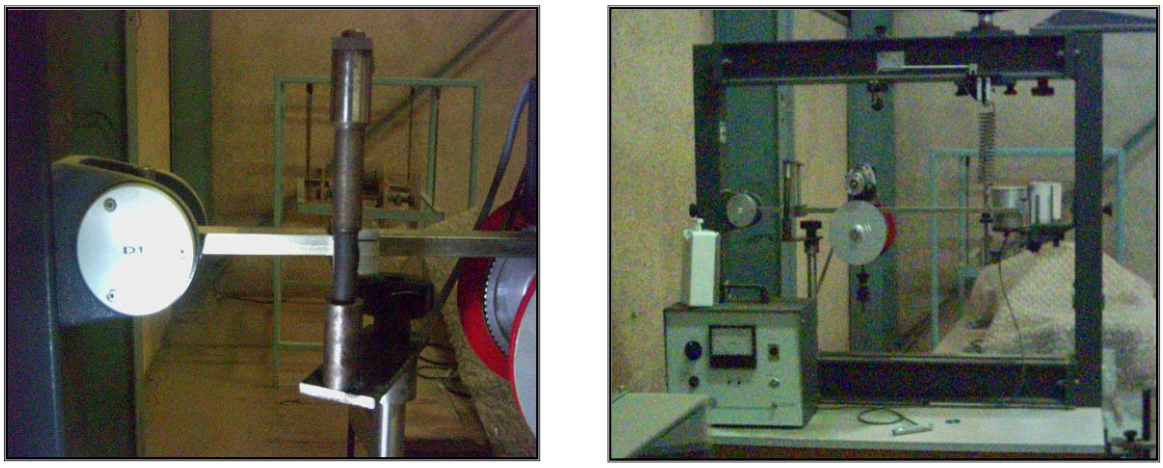
Table(1) different rubber composite

A- composite of LDPE/SBR/Reclaim		**B- composite of LDPE/IIR**		**C- composite of NR /SBR**	
Materiel	pphr	Materiel	pphr		pphr
SBR	100	IIR	100	NR	100
ZnO	1.5	ZnO	1.5	ZoN	8
Staric acid	1	Staric acid	1	St-A	1.45
P-oil	8	P-oil	8	p-oil	3
S	17	S	17	S	5.63
TMQ	1	TMQ	1	6PPD	2
CB	1	CB	1	Rencit	0.1
Reclain mesh 40	12	Reclain mesh 40	12	CTP-100	0.4
Miero Wax	1	Miero Wax	1	CB	72
CB	40	CB	40	Phenolic tack resin	0.8
6PPD	1	MBTS	1.08	SBR	0-100
LDPE	4,8,12, 16,20	LDPE	4,8,12, 16,20		

B. Testing: Damping characteristics(ζ,Δ,η,T)are measured by conducting of free vibration method by using the TM16 universal vibration with modified a viscous damping unit into rubber damping unit. Descriptions of this apparatus is as shown Fig. (1)and fig(2)



TM 16 Universal Vibration fig (1)
A-Viscose damper
B-Rubber damper
C- Complete system



B A

fig(2) TM 16 Universal Vibration

modification A- before modification B-after

C. Testing Procedure:

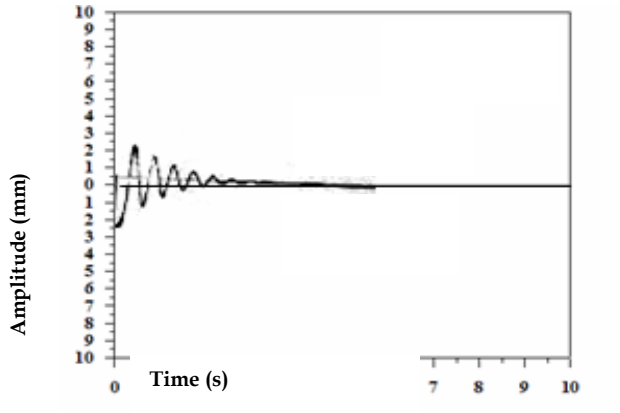
Free vibration test is conducted for each types of the prepared samples and as following :

1. preparing the cylindrical sample with dimensions are (d=14mm) and L= 8cm as shown in fig(3-B) to obtain required excitation displacement is (9) mm on free end as shown in fig(1-C)

2. Recording the free vibration curves as shown in fig(4).

3. Calculation the damping characteristics(ζ,Λ,η,T)from these results.

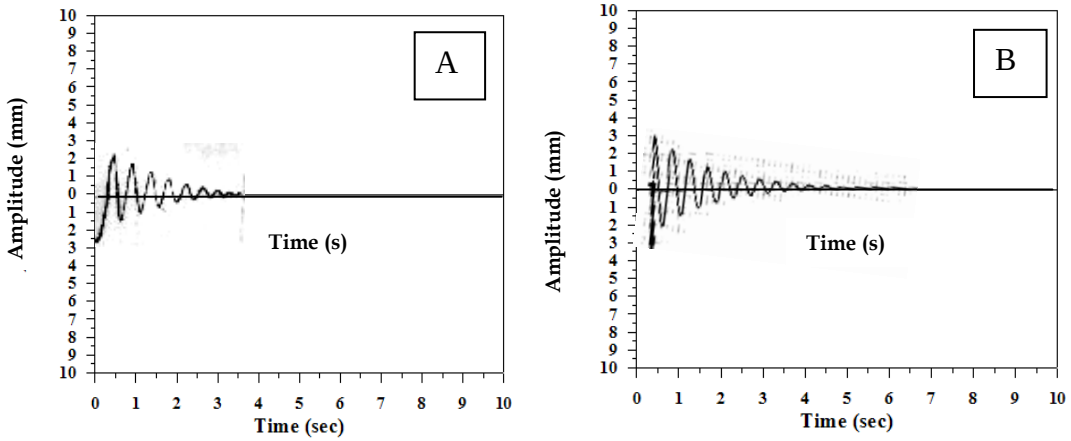
fig(3)A- die ,B-rubber sample



Fig(4) free vibration wave

Results and Discussion:

Pre-calibration test was carried to verify the responsibly of the modified part(Rubber damper) on M16 universal vibration apparatus. Free vibration test is conduced on the trade mounding of different sources .Results of this test are shown in Fig.(5 -A, B) .from these figures can be calculate of the different damping characteristic (ζ,Δ,η,T). Also there are anther characteristic are R% and to are measured directly by using Wallace R-2 Dunlop Triposometer. mounting. These characteristics are listed in table (2) . From These values which represent the Initial prediction of the characteristics can be concluded average of these characteristics for trade mounting. the overall mounting characteristics and properties are useful for comparison with the prepared mounting as shown in the final conclusion.



these characteristics until to 10%pphr of LDPE beyond this Value the characteristics begins to drop, that because of increasing of short and long branches in LDPE series leads to decreasing the free volume fraction slightly until the 10%pphr value
but, after this value it begins to disappear ,also because of LDPE is semi –crystalline polymer and those lead to increase the rigidity of the rubber recipe and then decreasing the damping characteristics.

Tabl1(2) trade damping characteristics

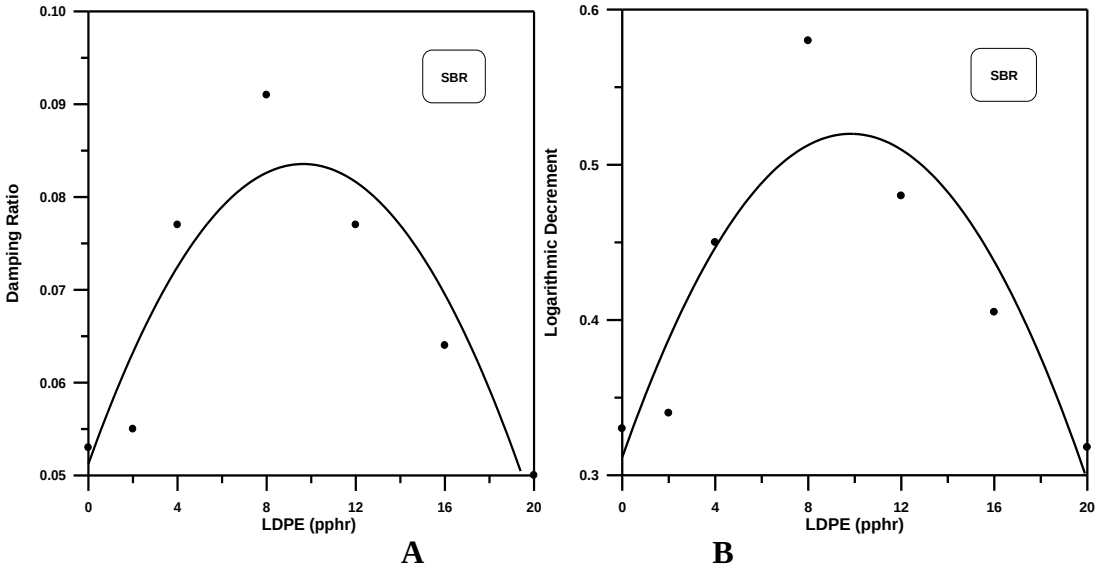
characteristics	Local pad	pad Foreign	Average
R%	57.5	47.14	52.32
t_o(s)	33.36	25.33	29.3
Δ	0.283	0.356	.319
ζ	0.0513	0.0566	0.0359
T%	8.9	8.4	9.1
C(N.s/m)	19.7	22.58	21.14

2-Addition of LDPE into IIR structure type:

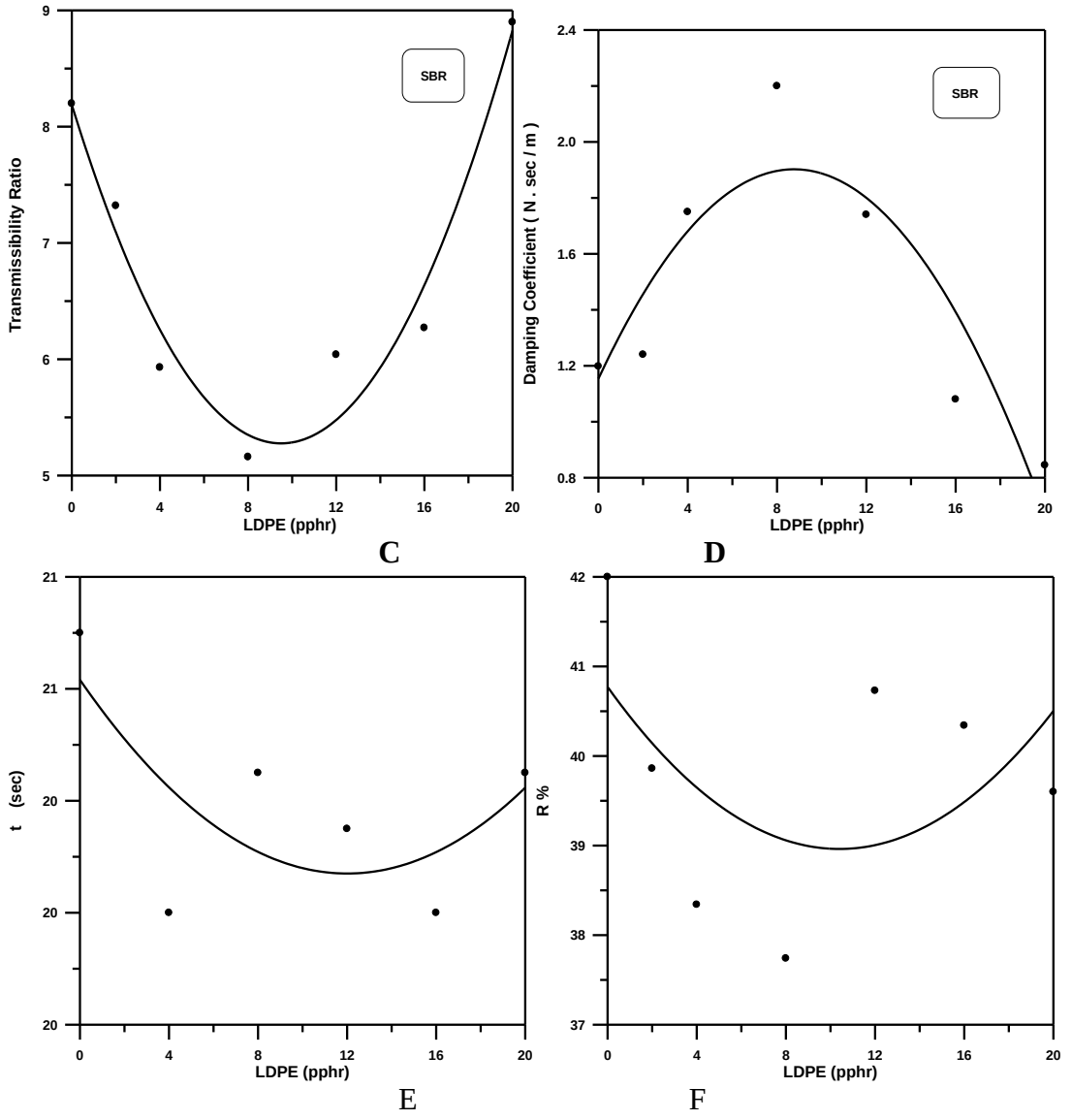
From fig(7-A-F) which represent damping characteristics of the modified rubber mounting with percentages of LDPE, can be observe the improvement of these characteristics until to 10%pphr of LDPE beyond this Value the characteristics begins to drop and that because of the same reasons .

3-Addition of SBR into NR structure type:

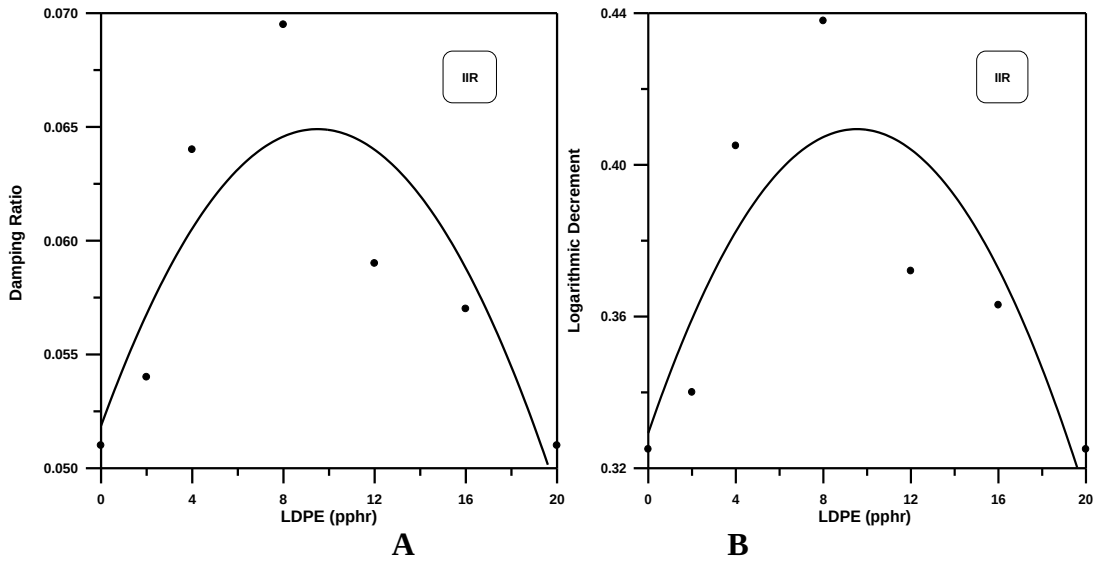
From fig(8A-F) which represent damping characteristics of the modified rubber mounting prepare of addition SBR into NR ,from these curves can be observe the improvement of these characteristics until the 50-60pphr of SBR that because of NR is semi –crystalline rubber while SBR is amorphous for this their mixture is closely to amorphous structure rather than semi –crystalline .this structure causes decreasing of rigidity and then increasing of damping characteristics beyond this value the characteristics begin to drop and that because of decreasing the free volume fraction, also, there is anther reason to explain this behavior is there is the phenyl group in SBR rubber leads to prevent the packing of series and then increasing the free volume fraction between them and that increases the damping characteristics and vise -versa .

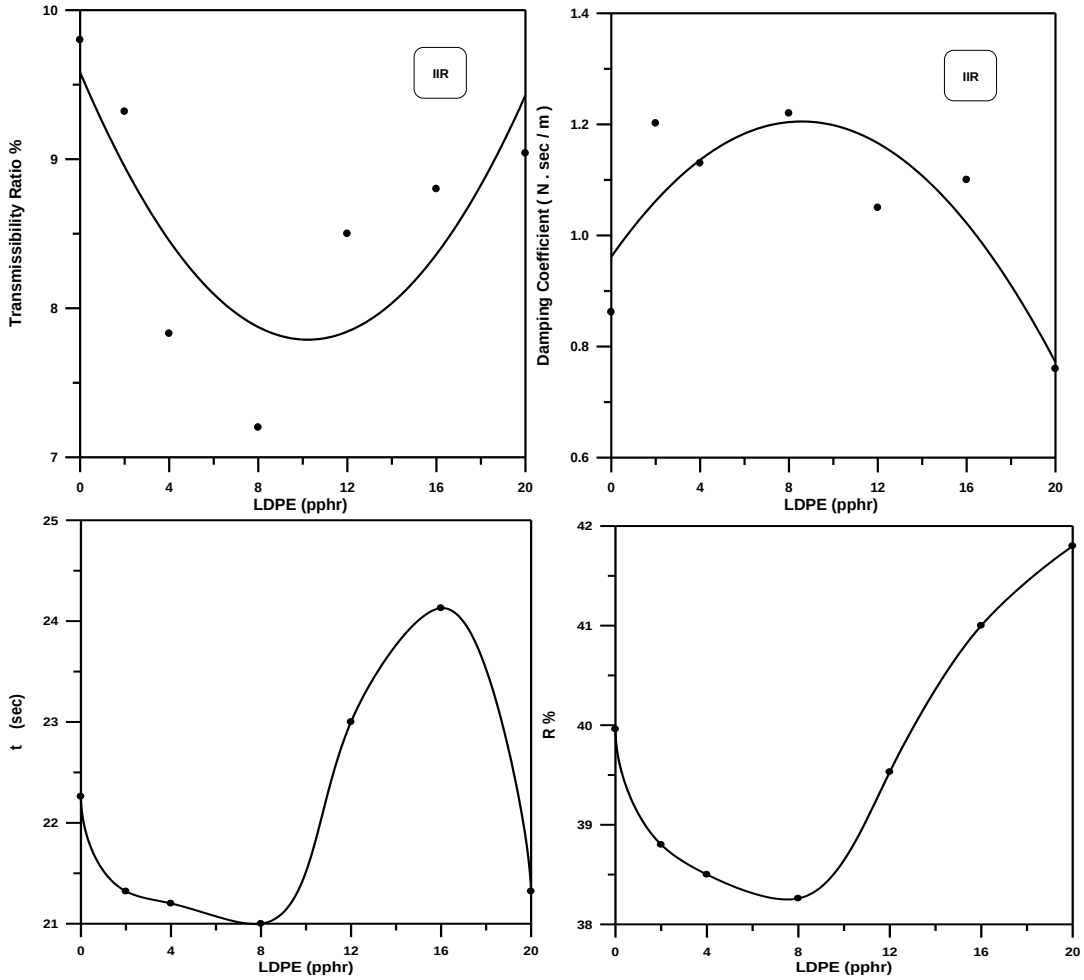


A **B**



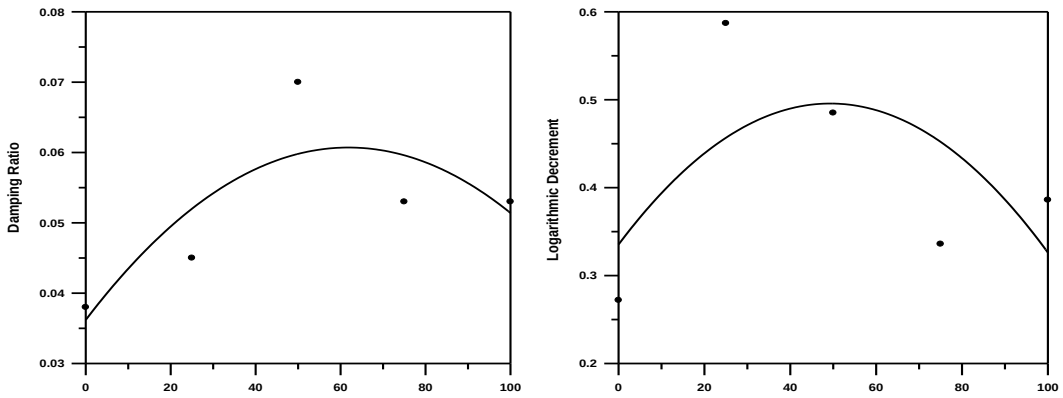
Fig(6)effect of LDPE on damping characteristics for SBR/ Reclaim rubber matrix



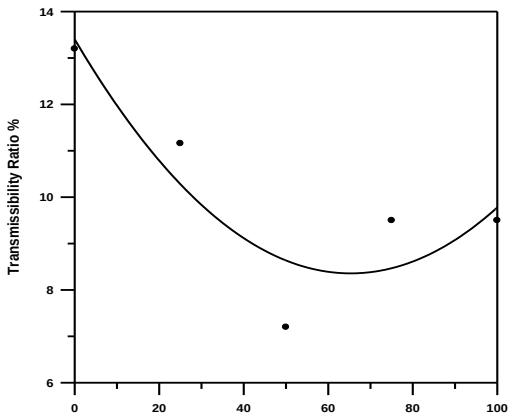


F **E**

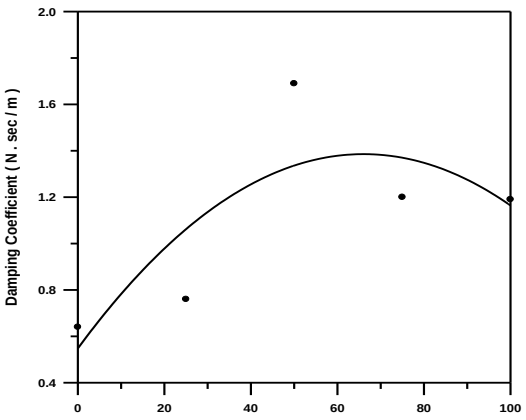
Fig(7)effect of LDPE on damping characteristics for IIR rubber matrix



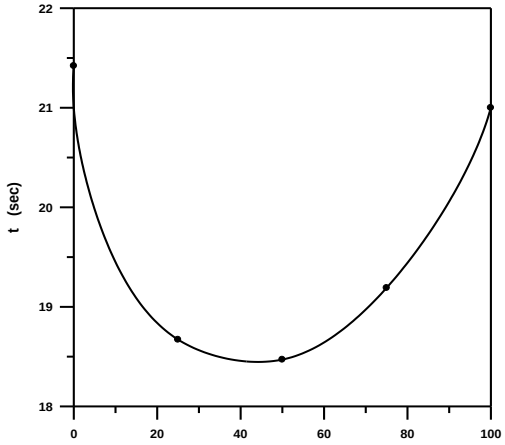
A SBR pphr B SBR pphr



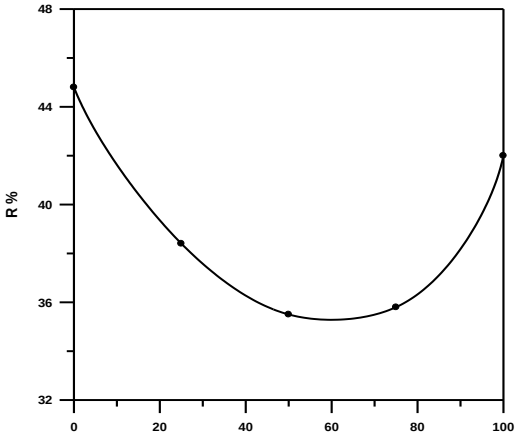
C SBR pphr



D SBR pphr



E SBR pphr



F SBR pphr

Fig(8)effect of SBR on damping characteristics for NBR rubber matrix

CONCLOSOIN :

From the previous results there are three identified rubber composite at 10% of LDPE with SBR/ Reclaim , IIR and 50-60% of SBR with NR **,**but the best types of these composite is at 10% of LDPE with SBR/ Reclaim as shown in table(3) .

Table (3) the comparison between the prepared and foreign pad

pad	t_0	R%	C	T	ζ	Δ
foreign pad	29.3	52.32	1.14	9.1	0.053	0.3295
LDPE/ IIR	21	38.25	1.2	7.8	0.065	0.41

SBR/NBR	18.5	35.2	1.4	8.2	0.079	0.5
LDPE/SBR Reclaim	21	39.1	1.88	5.28	0.0825	0.52

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