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APPENDIX

APPENDIX-A

Frequency (Hz)	Amplitude (μm)	Tensile Strength (MPa)	Yield Strength (MPa)	%E	Micro-Hardness (HV)	Toughness
Stationary	-	152.6	130.7	2.18	68.64	2
100	5	188.2	148.5	3.29	77.42	3.5
200	5	196.6	152.6	4.15	88.20	4.5
300	5	201.3	162.5	4.72	96.45	5
400	5	212.2	167.4	5.87	106.36	5.5
100	10	160.5	140.8	3.05	74.85	3
200	10	165.7	145.9	3.58	85.20	3.5
300	10	174.5	156.3	4.02	92.60	4
400	10	190.5	160.4	4.43	102.02	4.5
100	15	156.4	137.4	2.67	72.42	2.5
200	15	160.4	142.5	3.25	79.25	3
300	15	170.8	148.8	3.64	89.42	3.5
400	15	175.4	153.6	4.08	98.45	4

Table A. 1 Mechanical properties of A319 aluminum alloy casting with stationary and under oscillatory conditions

Frequency (Hz)	Amplitude (μm)	Tensile Strength (MPa)	Yield Strength (MPa)	%E	Micro-Hardness (HV)	Toughness
Stationary	-	158	115.6	3.6	60	2
100	5	177.5	127.45	4.5	66.7	3.5
200	5	182.6	135.46	4.8	72	4
300	5	200.5	138.72	5.5	79	5
400	5	216.08	140.54	7.5	85.8	6.5
100	10	174.5	125.54	4.2	65.8	3
200	10	176.4	130.58	4.35	70.5	3.5
300	10	188.6	132.52	5.2	75.5	4.5
400	10	208.47	136.87	6.5	81.9	5.5
100	15	165.2	119.42	3.78	63.8	2.5
200	15	180.1	126.57	4.08	68.5	3
300	15	186.3	129.54	5	73.8	3.5
400	15	196.2	132.86	5.8	77.4	4.5

Table A. 2 Mechanical properties of A356 aluminum alloy casting with stationary and under oscillatory conditions

Mould Frequency(f)	Amplitude	Avg. Silicon Particle Size		Avg. Area (μm^2)	Avg. Aspect Ratio	Avg. Shape Factor	Avg. Roundness	Average Grain Size of α-Al
(Hz)	µm	Length (µm)	Width (µm)				(%)	(µm)
Stationary	-	29.076	10.32	182.787	2.818	0.037	27.311	55.85
100	5	18.257	7.874	92.959	2.318	0.027	36.548	48.24
200	5	14.414	6.467	69.99	2.229	0.022	44.8	40.72
300	5	10.702	7.034	50.618	1.521	0.017	57.961	36.84
400	5	6.957	4.7	23.278	1.48	0.015	66.222	28.54
100	10	26.811	13.22	141.855	2.02	0.034	32.056	52.35
200	10	23.244	12.772	110.922	1.82	0.03	38.132	49.80
300	10	14.77	10.932	77.02	1.352	0.014	49.452	42.48
400	10	9.77	7.554	40.151	1.293	0.019	53.43	37.52
100	15	28.101	12.8	177.638	2.195	0.036	29.56	54.50
200	15	23.213	11.335	128.647	2.047	0.031	36.851	50.85
300	15	18.145	10.053	112.987	1.814	0.025	47.132	48.74
400	15	10.656	6.859	53.899	1.554	0.02	50.241	40.92

Table A.3 Metallurgical properties of A319 aluminum alloy casting with stationary and under oscillatory condition

Mould Frequency(f)	Amplitude	Avg. Silicon Particle Size		Avg. Area (μm^2)	Avg. Aspect Ratio	Avg. Shape Factor	Avg. Roundness	Average Grain Size of α-Al
(Hz)	µm	Length (µm)	Width (µm)				(%)	(µm)
Stationary	-	29.076	10.32	1318.47	2.818	0.037	27.311	49.19
100	5	18.257	7.874	469.07	2.318	0.027	36.548	42.79
200	5	14.414	6.467	385.61	2.229	0.022	44.8	36.15
300	5	10.702	7.034	231.98	1.521	0.017	57.961	29.53
400	5	6.957	4.7	186.18	1.48	0.015	66.222	20.53
100	10	26.811	13.22	780.85	2.02	0.034	32.056	44.82
200	10	23.244	12.772	510.68	1.82	0.03	38.132	41.6
300	10	14.77	10.932	412.41	1.352	0.014	49.452	34.72
400	10	9.77	7.554	280.7	1.293	0.019	53.43	24.4
100	15	28.101	12.8	890.2	2.195	0.036	29.56	46.96
200	15	23.213	11.335	725.18	2.047	0.031	36.851	43.95
300	15	18.145	10.053	620.5	1.814	0.025	47.132	38.5
400	15	10.656	6.859	405.23	1.554	0.02	50.241	28.7

Table A. 4 Metallurgical properties of A356 aluminum alloy casting with stationary and under oscillatory conditions

Si	Fe	Ni	Cu	Mg	Zn	Sn	V
7.16	0.14	0.043	0.077	0.35	0.064	0.073	0.013

Table A. 5 Chemical Composition of A356 Aluminum Alloy

Si	Fe	Mn	Cu	Mg	Ti	Zn	V
5.78	0.43	0.29	3.75	0.05	0.03	0.06	0.011

Table A.6 Chemical Composition of A319 Aluminum Alloy

APPENDIX-B

Figure B.1 Dewinter Trinocular Metallurgical Microscope

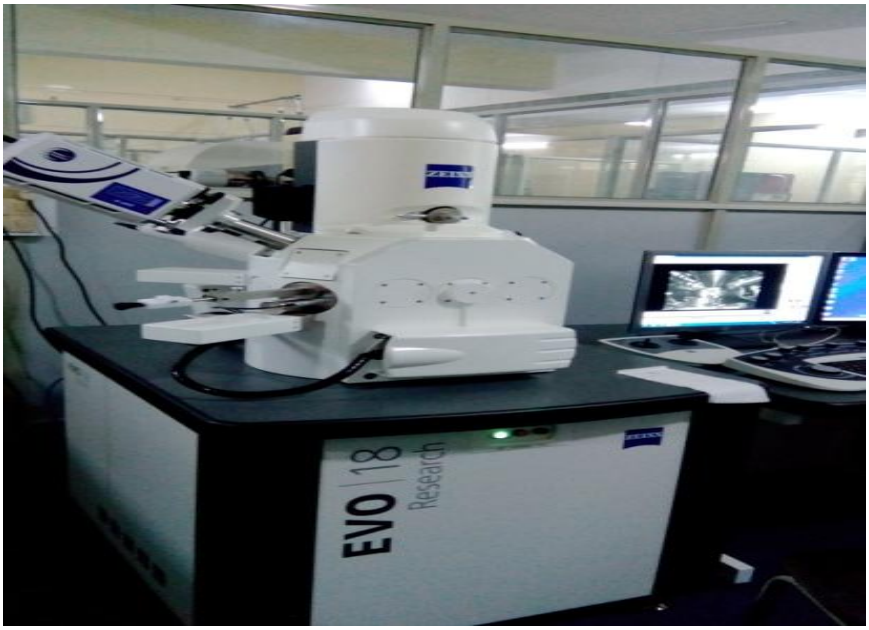

Figure B.2 Scanning Electron Microscope (EVO-18)

Figure B**.3 X-ray diffraction Machine (XRD) (Model: RIGAKU, ULTIMA-IV H-12-JAPAN)**

Figure B.4 Density and Porosity Measurement Set-Up

Figure B.5 Tinius Olsen Micro Hardness Tester

Figure B.6 UTM(Instron)

Figure B.7 Set-Up for Charpy Test

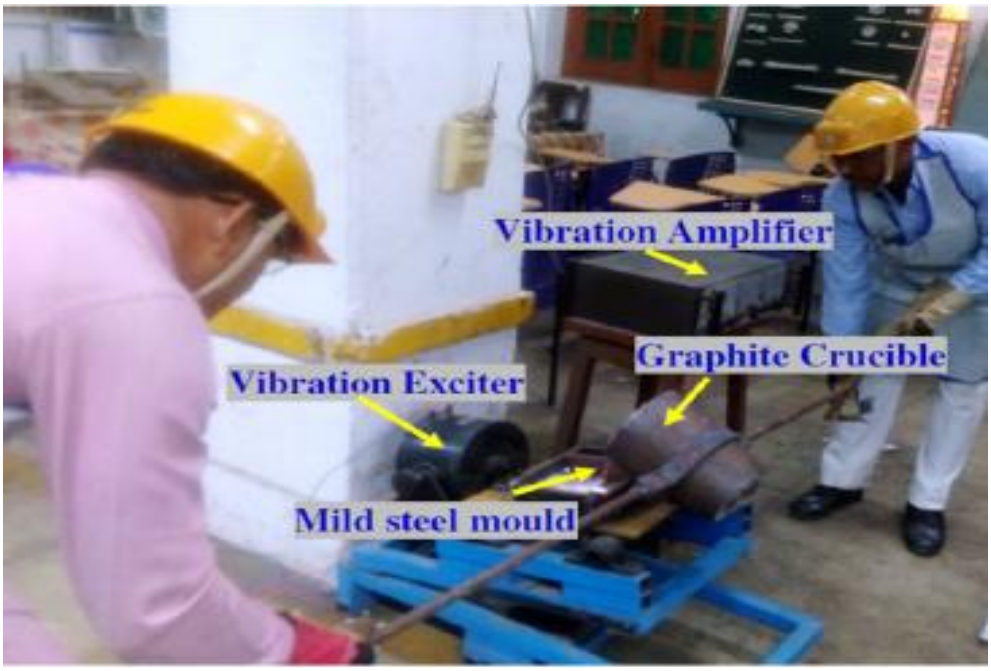

Figure B.8 Experimental Set-up

APPENDIX–C

SPECIFICATIONS OF THE INSTRUMENTS USED

C.1 Vibration Generator (Exciter)

Make	: Messelektronik Dresden RFT (Made in Germany)
FABRNR	: 21001
Type	: 11077 VEB
Frequency range	: 1Hz to 10KHz
Wave form	: Sinusoidal

C.2 Vibration Pick Up

Make	: Industrial Electronics Pvt. Ltd., Bangalore
Type	: CVP 3001
S.No	: 529
Range, Displacement	: 0-1000 microns
Velocity	: 0-1000 mm/sec
Frequency	: 0-10 KHz
Accuracy	: +2%

C.3 Oscillator/Power amplifier

Make	: Industrial Electronics Pvt. Ltd., Bangalore
Model	: 9701
Wave form	: Sinusoidal
Frequency Range	: 1Hz to 10KHz in four decade ranges
Frequency Indication	: Rectangular Panel Meter
Accuracy	: +2% of FSD
Total Harmonic Distortion	: 1.0% at maximum output amplitude
Maximum Output Voltage	: 6 Volts peak to peak into 600 ohms
Power Consumption	: 20 V.A.

C.4 Vibration Meter

Make	: Industrial Electronics Pvt. Ltd., Bangalore
Type	: 410 C
S.No.	: 233
Power Supply	: 230V, 50Hz, Single phase A.C.
Range, Displacement	: 0-1000 microns PP
Velocity	: 0-1000 mm/sec
Frequency	: 0-10.000 Hz
Accuracy	: +2% F.S.

C.5 Multimeter

Make	: Philips, India
Type	: 2502

C.6 Clamps

C-clamps	: 4” maximum opening

C.7 Instron Machine

Make	: Instron Pvt.Ltd., Canada
Type	: TT-CM-L
Capacity	: 2.5-5 Ton
Testing Speed Range	: 0.005 -5 cm/min
Cross Head Travel	: 38 inch
Cross Head Speed Range	: 0.002-20 inch/min
Cross Head Speed Range	: 0.002-20 inch/min

C.8 Optical Microscope

Model : Dewinter Trinocular Metallurgical Microscope

Eyepiece : Paired 15X and 10X

Magnification : 50X to 1000X

Power : 12Volt, 50Watts Halogen lamp

C.9 Scanning Electron Microscope

Make : Carl Zeiss, Germany

Filament : Tungsten

Secondary e-image resolution : 50 NM (Depends on sample)

Magnification : Up to 50K ~ 100K (Depends on sample)

Rotation : 360 Degree

Tilt : 0 - 60 Degree

EHT : 200V - 30KV

C.10 X-Ray Diffracto-meter

Make : Rigaku, Ultima IV, Japan

Filament : Tungsten

Model : 2036E201

Goniometer model : 2036E201 [Cu K_α radiation (K_α= 1.54056 A^0)]

Structural changes and phase transformations: JADE software

Secondary e-image resolution : 50 NM (Depends on sample)

Magnification : Up to 50K ~ 100K (Depends on sample)

Rotation : 360 Degree

Tilt : 0 - 60 Degree

EHT : 200V - 30KV

C.11 Micro-hardness Tester

Model	: Tinius Olsen, Horsham, PA USA Redhill, Surrey UK
Hardness value	: 5 digits
Magnification	: up to 1000
Test force selection	: Manual
Test procedure	: Automatic, loading/dwell/unloading
Test force accuracy	: <1% for test force 200g to 2Kg <1.5% for test force below 100g
User display value,	: Length of diagonals, hardness value, converted test force, online statistics
Optical path	: 2 ways, eyepiece / CCD camera
Power requirements	: 100VAC to 240VAC, 50/60Hz, single phase