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APPENDICES

Appendix A

- A. THE RELATIONSHIP OF TORQUE, MELT TEMPERATURE, BREAK ENERGY AND POWER VERSUS TIME OF EVA/MODIFIED STARCH-BASED HOT MELT ADHESIVES THAT PROCESS IN BRABENDER BATCH MIXER

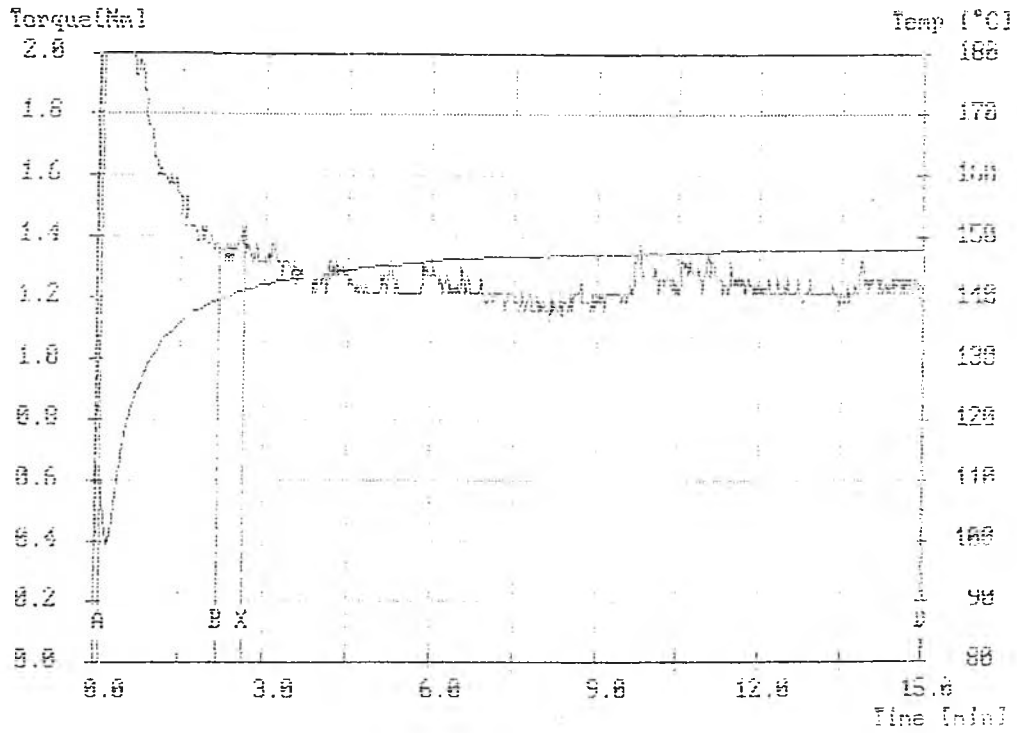
BRABENDER

Data-Processing PLASTI-CORDER PL2000 and Mixer Measuring Head
Heat & Shear Stability

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Test Conditions
Operator      : OPD
Temperature   : 140
Date         : 01.10.10
Dial Type    : 101
Mixer Type   : 2000
Load Type    : 1 + 5 kg
Chute       : HMA20/3 (No. starch)
Additive     :

Mixer Temp.  : 140
Mixer Speed : 100
Mixer Time   : 15
Sample Weight: 25.00
Sample Number: 147
Mixer Temp.  : 147
    
```



value	Time	Torque [Nm]	Stocktemp. [°C]
Loading Peak A	00:00:00	0.8	110
Minimum B	00:02:10	1.4	140
Maximum X	00:02:38	1.4	145
Decomposition D	00:14:58	1.0	145

```

Integration / Energy
- Loading Peak to Minimum      A - B : W1 = 1.00 [kNm]
- Minimum to Maximum          B - X : W2 = 0.00 [kNm]
- Maximum to Decomposition    X - D : W3 = 0.00 [kNm]
- Loading Peak to Maximum      A - X : W4 = 0.00 [kNm]
- Loading Peak to Decomposition A - D : W5 = 0.00 [kNm]
- Specific energy (W5/Sample weight) : W5 = 0.00 [kNm/g]
    
```

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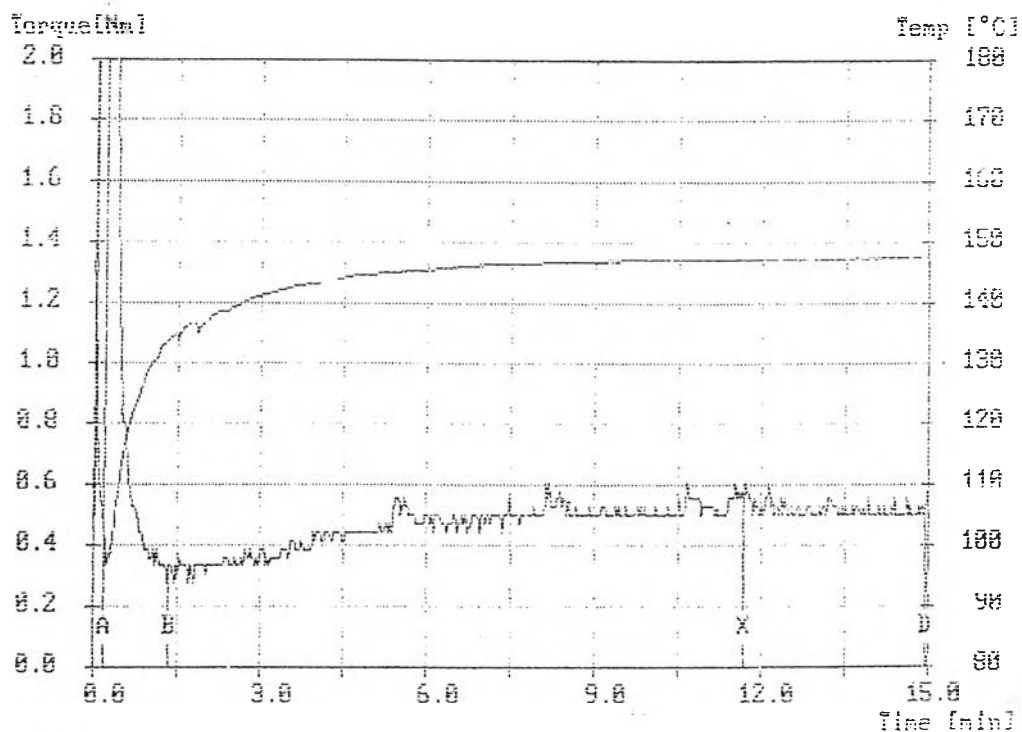
Results
- Fusion Time      A - A : T1 = 00:12:00
- Decomposition Time A - D : T2 = 00:14:58
    
```

Figure A2 The correlation of torque and melt temperature versus time of HMA20/3(M)

BRABENDER

Data-Processing PLASTI-CORDER PL2000 and Mixer Measuring Head
Heat & Shear Stability

Test Conditions			
Order	: ORD	Mixer Temp.	: 150 °C
Operator	: Arkom	Speed	: 6000 1/min
Test Date	: 25. Dec '01	Meas. Range	: 0.00 Nm
Pl. Type	: 2000-3	Zero Suppr.	: %
Mixer Type	: W 50	Damping	: 10.0
Load, Crute	: Manual + 5 kg	Test Time	: 15.0 min
Sample	: HMA 20/3 (native 30)	Sample Weight	: 35.00 g
Active	:	Code Number	:
		Start Temp.	: 147 °C



Value	Time	Torque [Nm]	Stocktemp. [°C]
Loading Peak A	00:00:12	7.2	103
Minimum B	00:01:20	0.3	134
Maximum X	00:11:42	0.6	147
Decomposition D	00:14:56	0.5	147

Integration / Energy

- Loading Peak to Minimum	A - B :	W1 =	0.4 [kNm]
- Minimum to Maximum	B - X :	W2 =	1.5 [kNm]
- Maximum to Decomposition	X - D :	W3 =	0.5 [kNm]
- Loading Peak to Maximum	A - X :	W4 =	1.9 [kNm]
- Loading Peak to Decomposition	A - D :	W5 =	2.4 [kNm]
- Specific Energy (W5/Sample Weight)	:	W5 =	0.1 [kNm/g]

Results

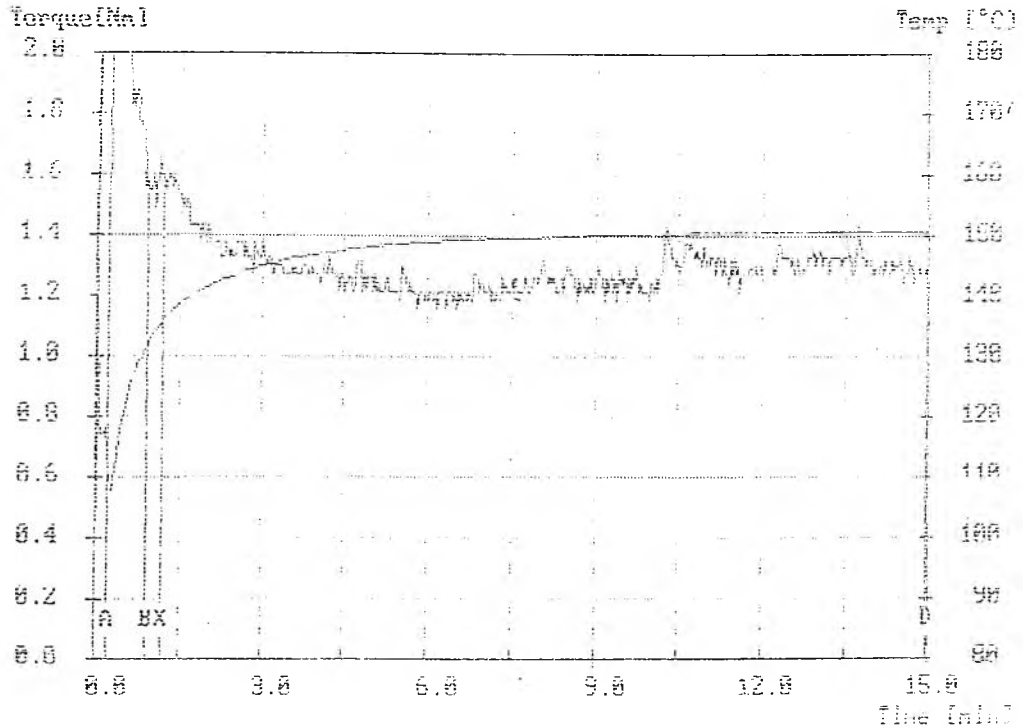
- Fusion Time	A - X :	t =	00:11:30
- Decomposition Time	A - D :	tD =	00:14:44

Figure A3 The correlation of torque and melt temperature versus time of HMA20/3(N)

BRABENDER

Data-Processing PLASTI-CORDER PL2000 and Mixer Measuring Head
Heat & Shear Stability

Test Conditions		
Order	: ORD	Mixer Temp.
Operator	: Arkom	Speed
Test Date	: 21. Mar '00	Meas. Range
Pl. Type	: 2000-3	Zero Suppr.
Mixer Type	: W 50	Damping
Load. Chute	: Manual + 5 kg	Test Time
Sample	: HMA40/5(MOD)	Sample Weight
Additive		Code Number
		Start Temp.



Value	Time	Torque [Nm]	Stoc. temp. [°C]
Loading Peak A	00:00:14	7.7	177
Minimum B	00:00:34	1.0	145
Maximum X	00:01:12	1.6	145
Decomposition D	00:14:58	1.3	145

Integration / Energy

- Loading Peak to Minimum	A - B	: W1 =	0.0	[kNm]
- Minimum to Maximum	B - X	: W2 =	0.0	[kNm]
- Maximum to Decomposition	X - D	: W3 =	0.0	[kNm]
- Loading Peak to Maximum	A - X	: W4 =	0.0	[kNm]
- Loading Peak to Decomposition	A - D	: W5 =	0.0	[kNm]
- Specific Energy (W5/Sample Weight)		: W6 =	0.0	[kNm/g]

Results

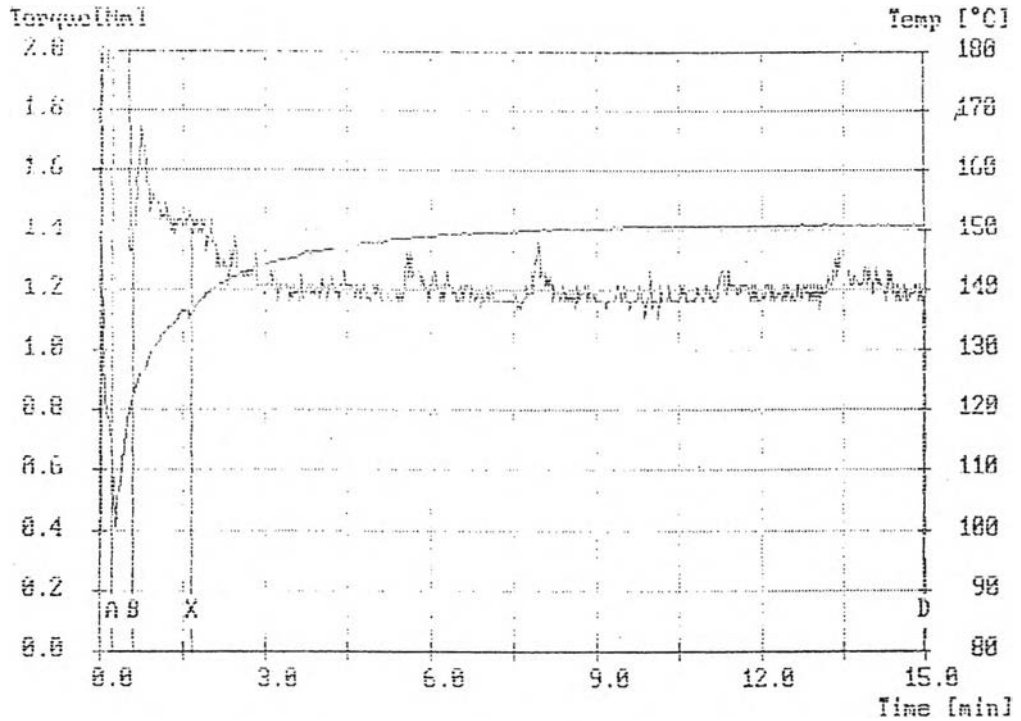
- Fusion Time	A - X	: t =	00:00:38
- Decomposition Time	A - D	: tD =	00:14:44

Figure A4 The correlation of torque and melt temperature versus time of HMA40/5(M)

BRABENDER

Data-Processing PLASTI-CORDER PL2000 and Mixer Measuring Head
Heat & Shear Stability

Test Conditions			
Order	MPA	Mixer Temp.	150 °C
Operator	AM	Speed	50 1/min
Test Date	2007.04.10	Meas. Range	50 Nm
PL Type	0007	Zero Suppl.	0 %
Mixer Type	A 25	Sampling	15.0
Load. Crute	MA40/5(N)	Test Time	15.0 min
Sample	HMA40/5(N)	Sample Weight	35.00 g
Additive		Code Number	
		Start Temp.	149 °C



value	Time	Torque [Nm]	Stocktemp. [°C]
Loading Peak A	00:00:14	5.6	110
Minimum B	00:00:36	1.4	122
Maximum X	00:01:40	1.4	136
Decomposition D	00:14:53	1.2	151

Integration / Energy

- Loading Peak to Minimum	A - B	: W1 =	0.4 [kNm]
- Minimum to Maximum	B - X	: W2 =	0.6 [kNm]
- Maximum to Decomposition	X - D	: W3 =	0.1 [kNm]
- Loading Peak to Maximum	A - X	: W4 =	0.9 [kNm]
- Loading Peak to Decomposition	A - D	: W5 =	0.9 [kNm]
- Specific Energy, (W5/Sample weight)		: W6 =	0.2 [kNm/g]

Results

- Fusion Time	A - X	: t =	00:01:26
- Decomposition Time	A - D	: tD =	00:14:44

Figure A5 The correlation of torque and melt temperature versus time of HMA40/5(N)

BRABENDER
 Data Processing Plasti-Corder PL2000 with Mixer measuring Head
 Correlation Program / 2.3

Selected Tests:	<input checked="" type="checkbox"/>	1. HMAEVA
	<input checked="" type="checkbox"/>	2. MOD20-3
	<input checked="" type="checkbox"/>	3. NAT20-3
	<input checked="" type="checkbox"/>	4. MO40-5
	<input checked="" type="checkbox"/>	5. MA40-5
Evaluation:		Heat & Shear Stability

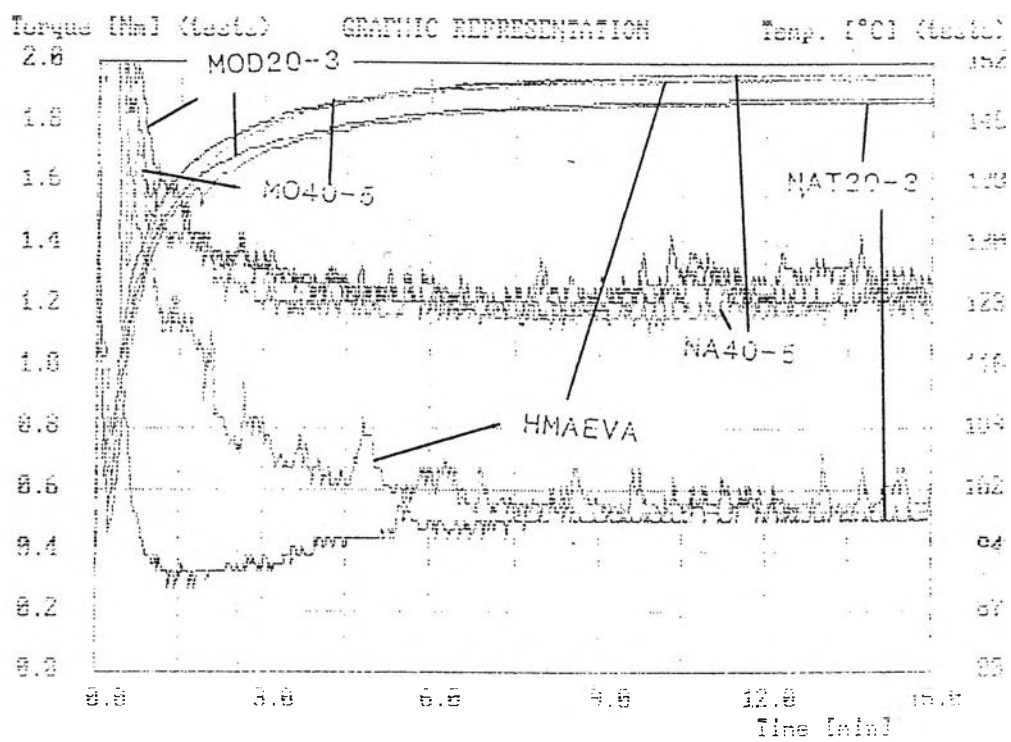


Figure A6 The correlation of torque and melt temperature versus time of MA(EVA), HMA20/3(M), HMA20/3(N), HMA40/5(M), HMA40/5(N)

Appendix B

- B. THE DSC THERMOGRAME OF INTERESTED EVA /MODIFIED STARCH-BASED HOT MELT ADESIVES WITH THEIR COMPOSITION INCLUDING EVA, ROSIN ESTER AND POLYETHYLENE WAX

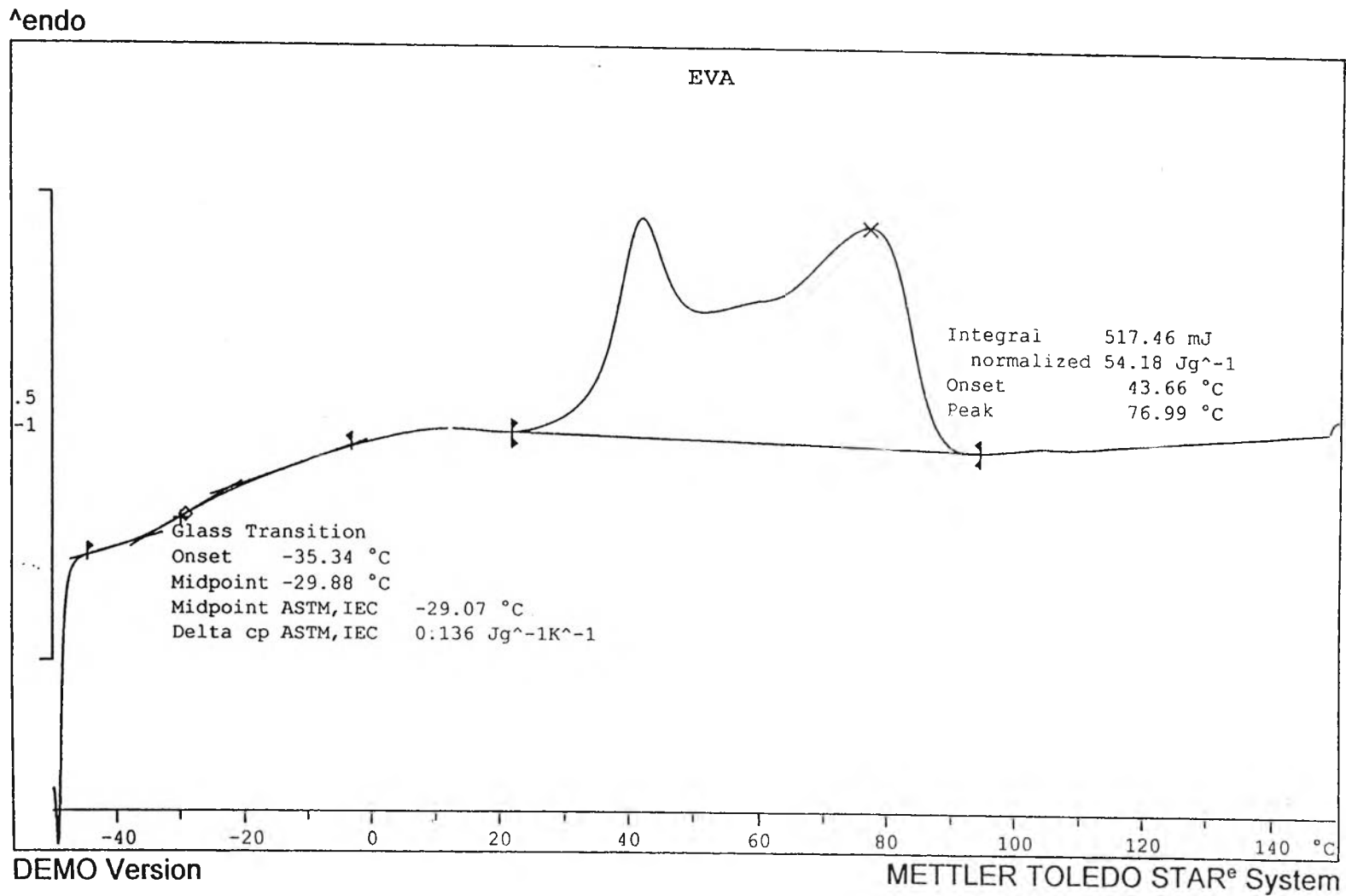


Figure B1 DSC thermogram of EVA

^endo

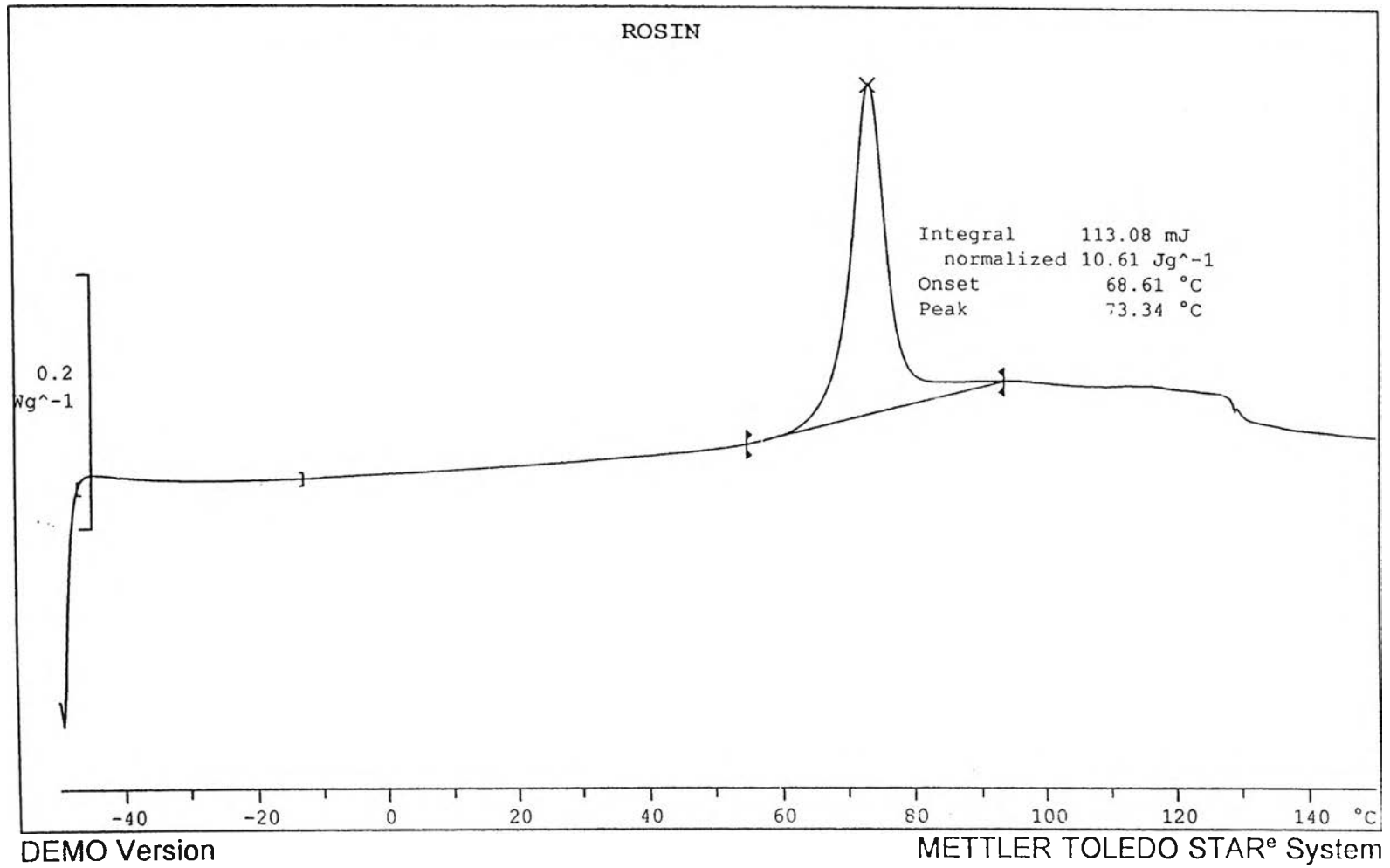


Figure B2 DSC thermogram of Rosin

^endo

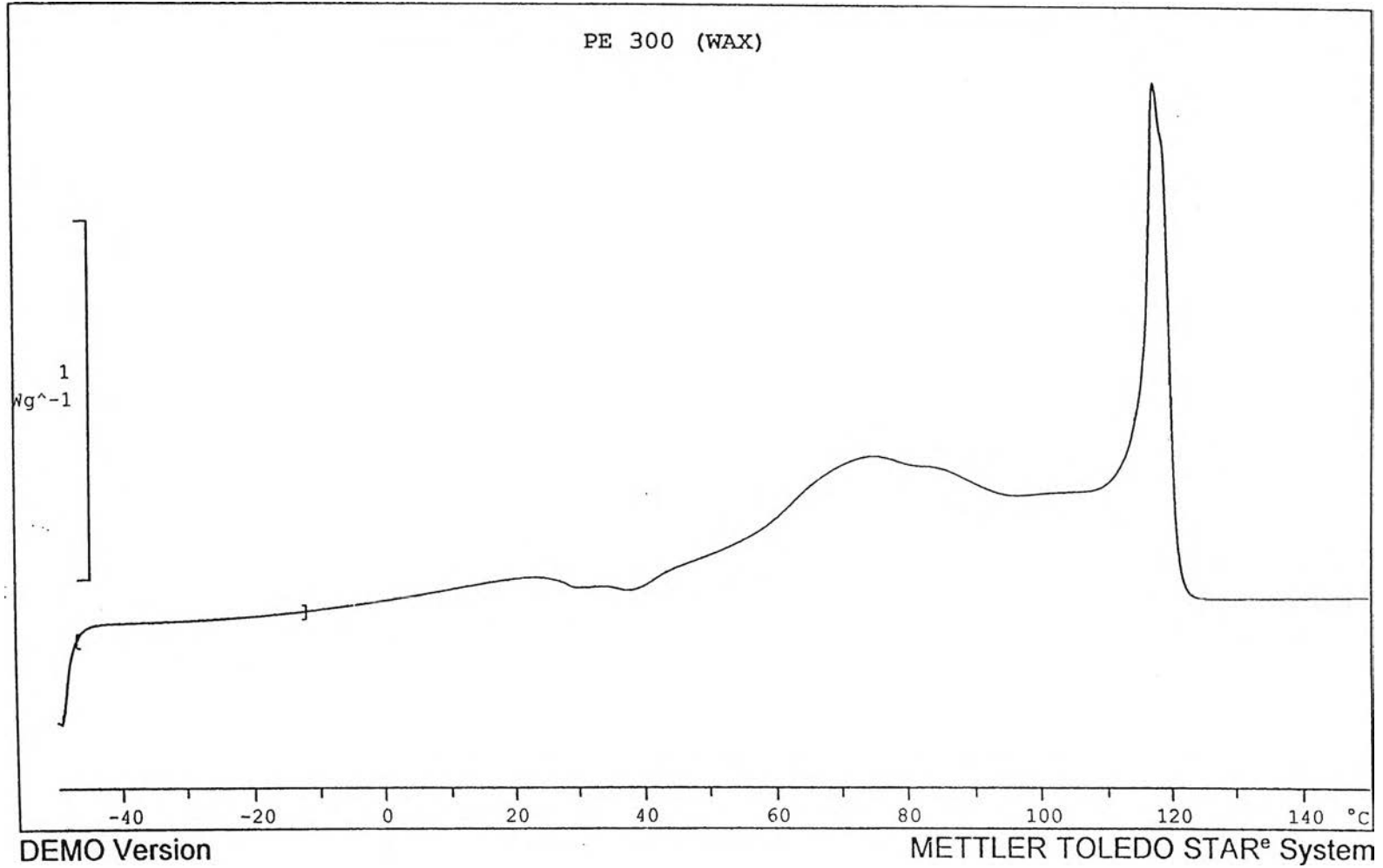
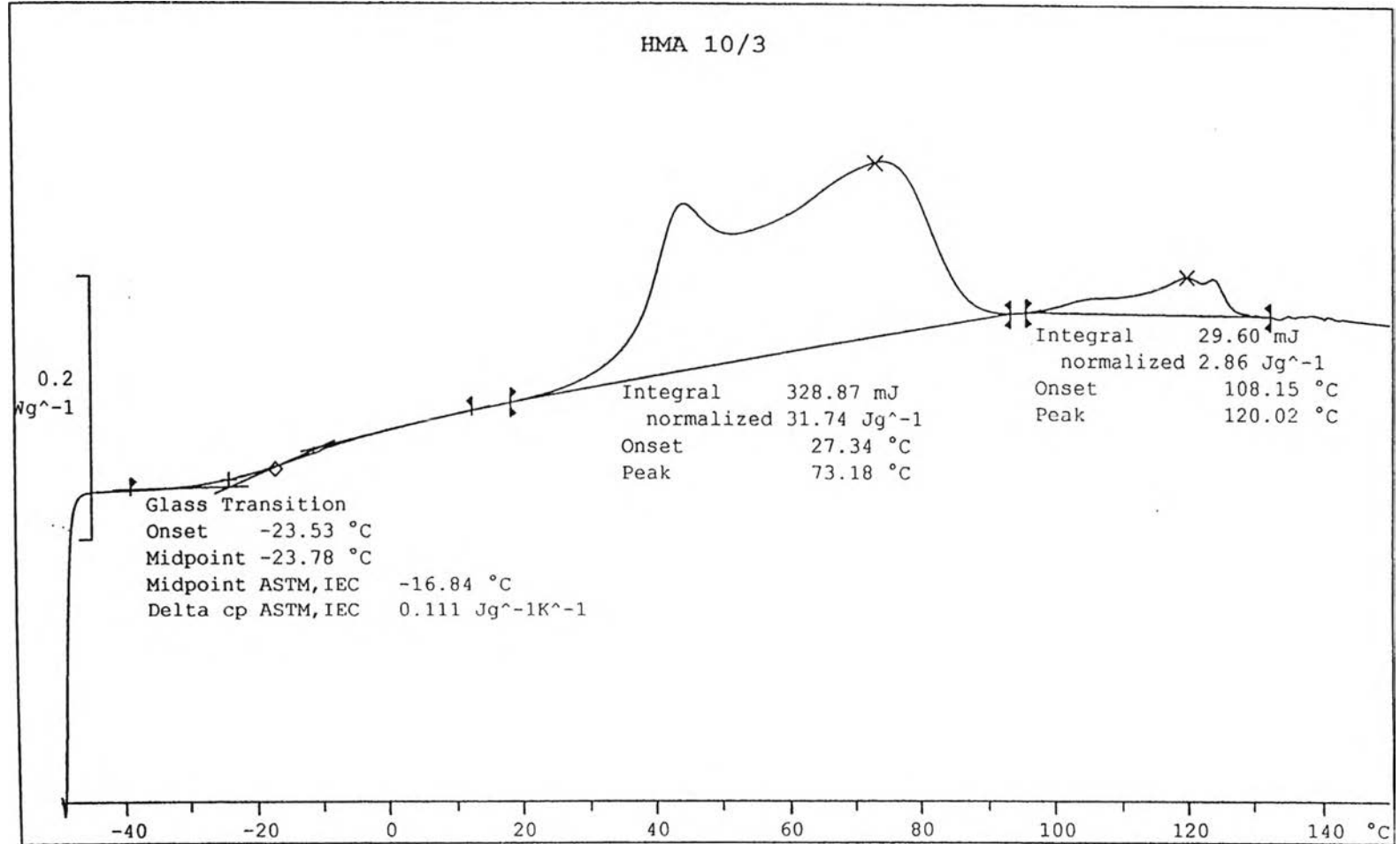


Figure B3 DSC thermogram of PE wax (PE300)

^endo



DEMO Version

METTLER TOLEDO STAR^e System

Figure B4 DSC thermogram of HMA10/3

^endo

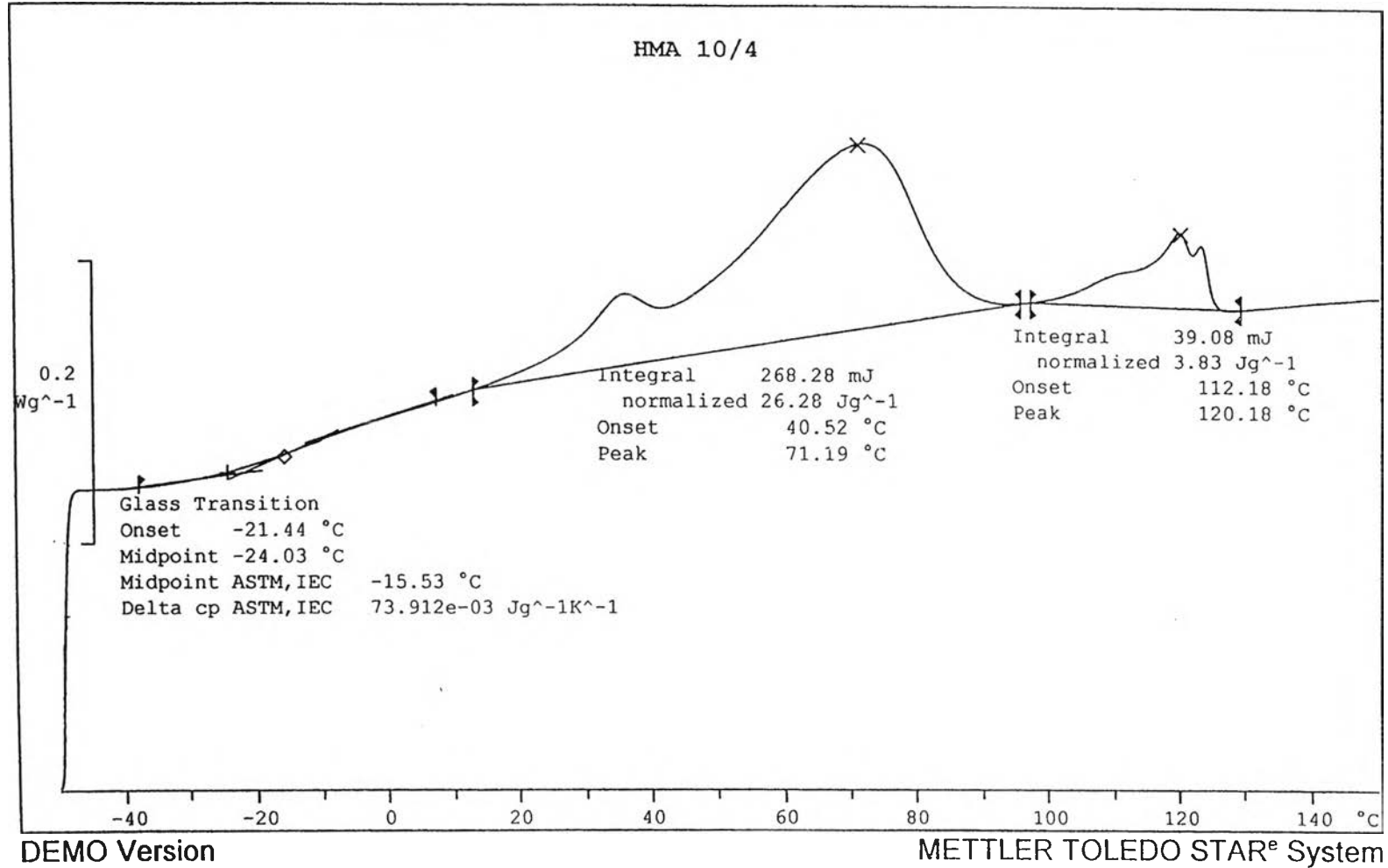
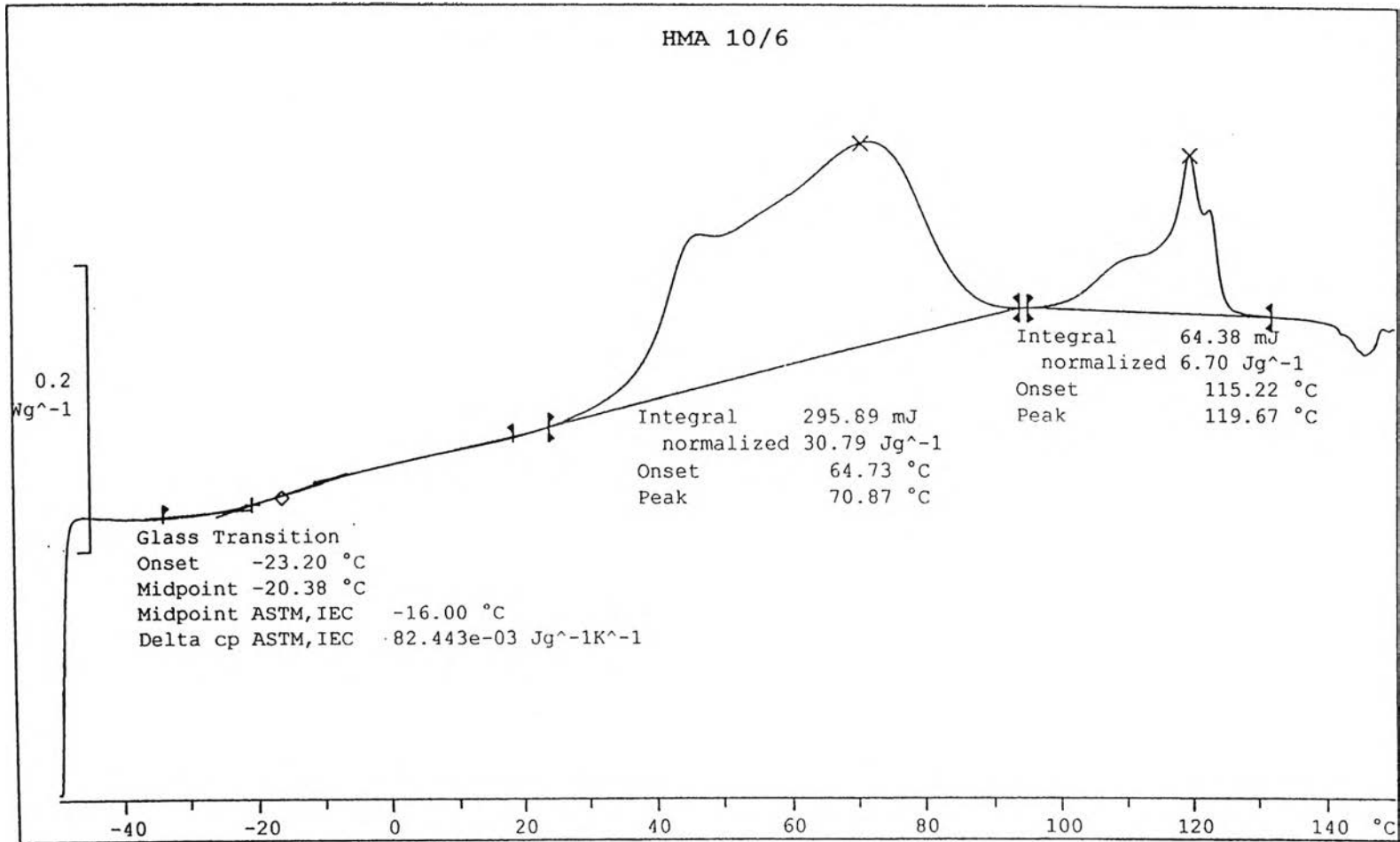


Figure B5 DSC thermogram of HMA10/4

^endo



DEMO Version

METTLER TOLEDO STAR^e System

Figure B6 DSC thermogram of HMA10/6

^endo

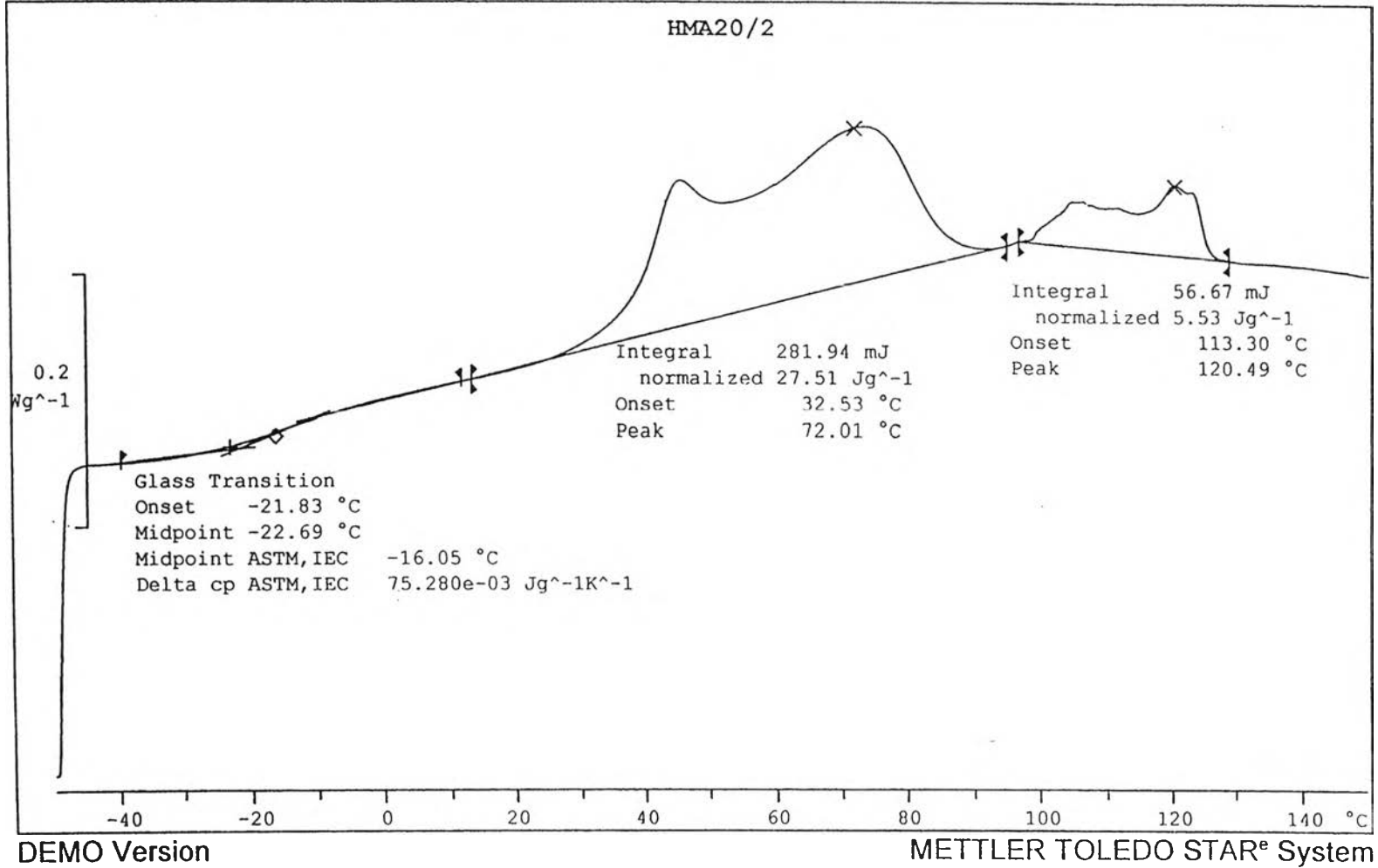
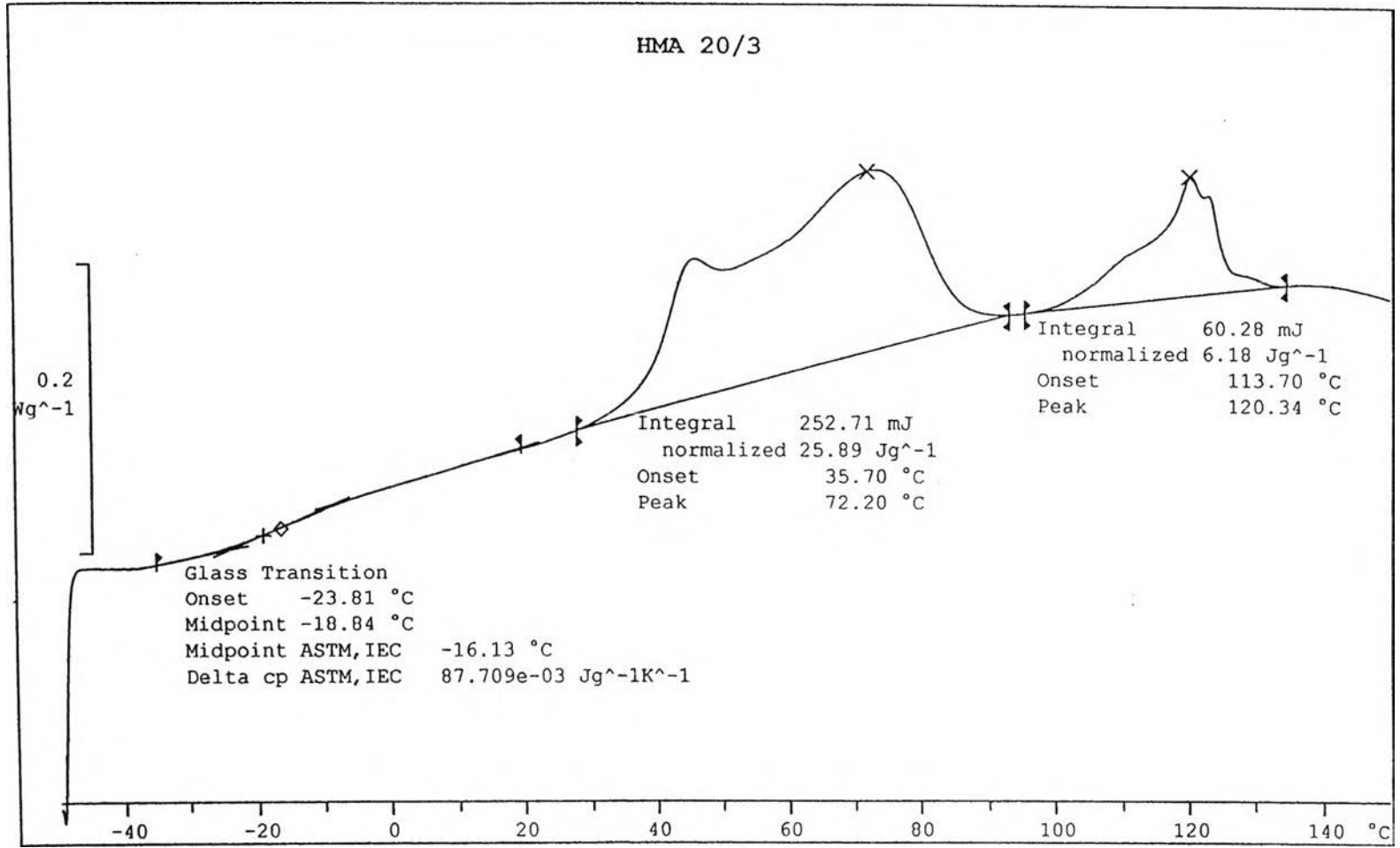


Figure B7 DSC thermogram of HMA20/2

^endo

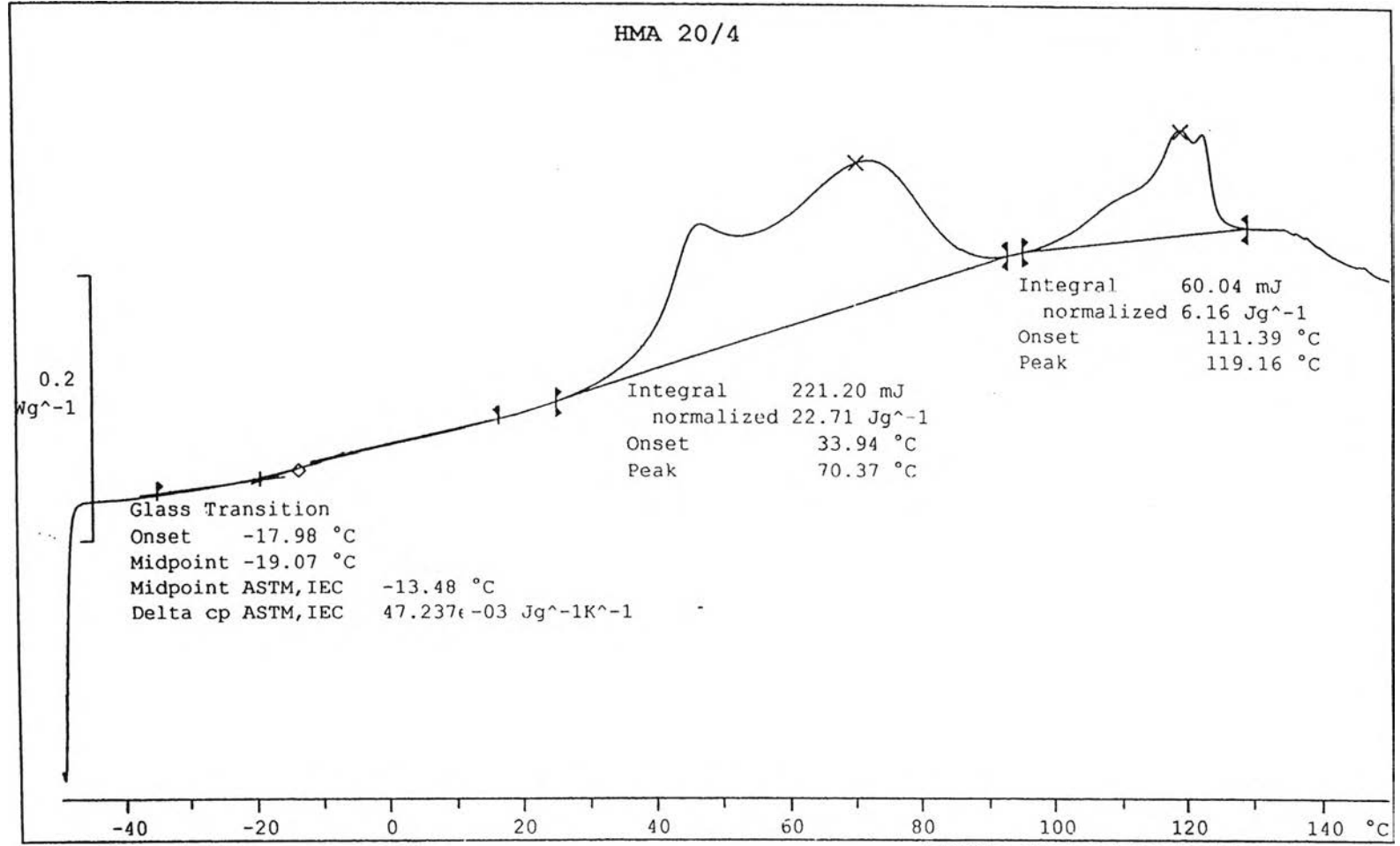


DEMO Version

METTLER TOLEDO STAR[®] System

Figure B8 DSC thermogram of HMA20/3

^endo



DEMO Version

METTLER TOLEDO STAR[®] System

Figure B9 DSC thermogram of HMA20/4

^endo

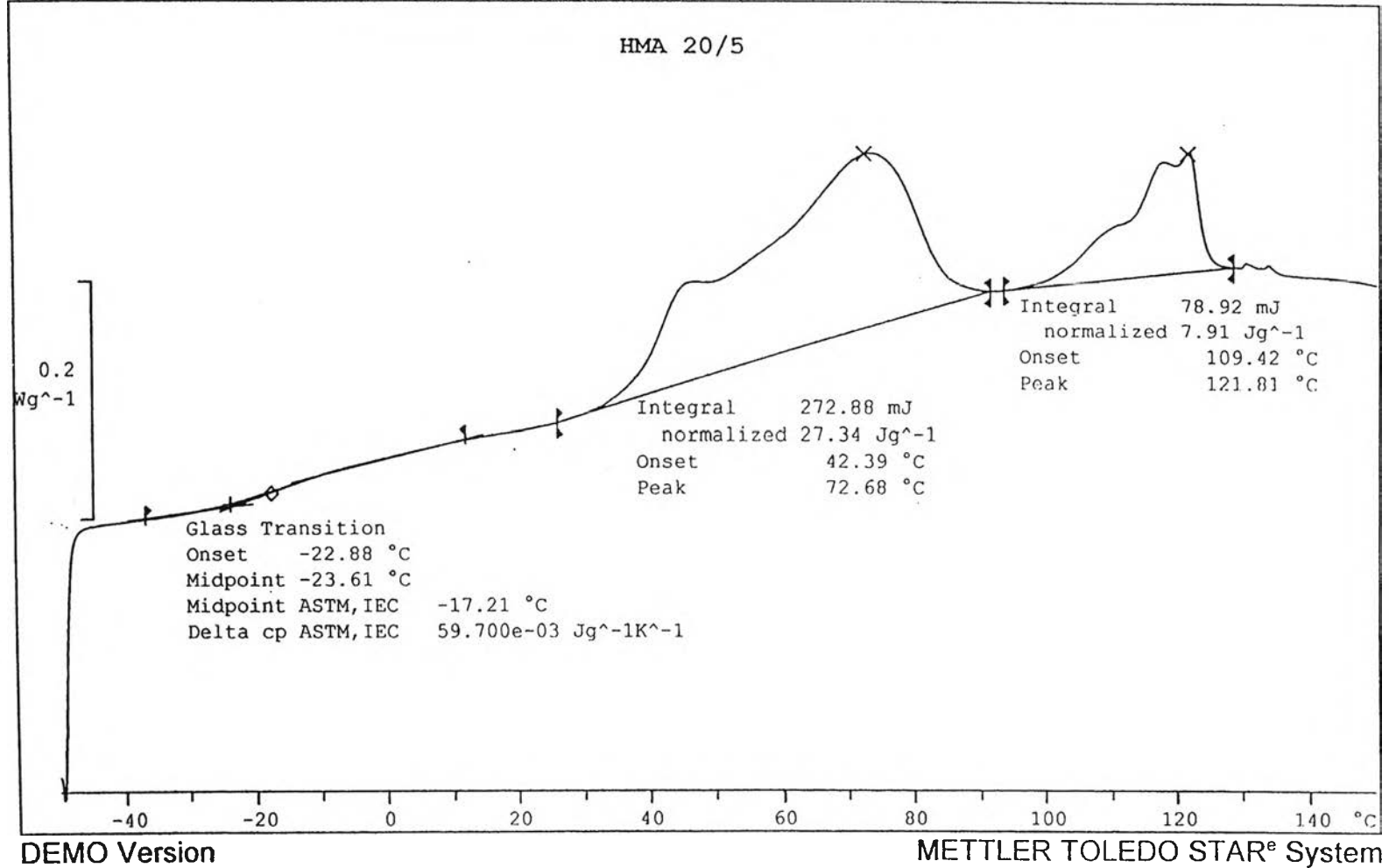


Figure B10 DSC thermogram of HMA20/5

^endo

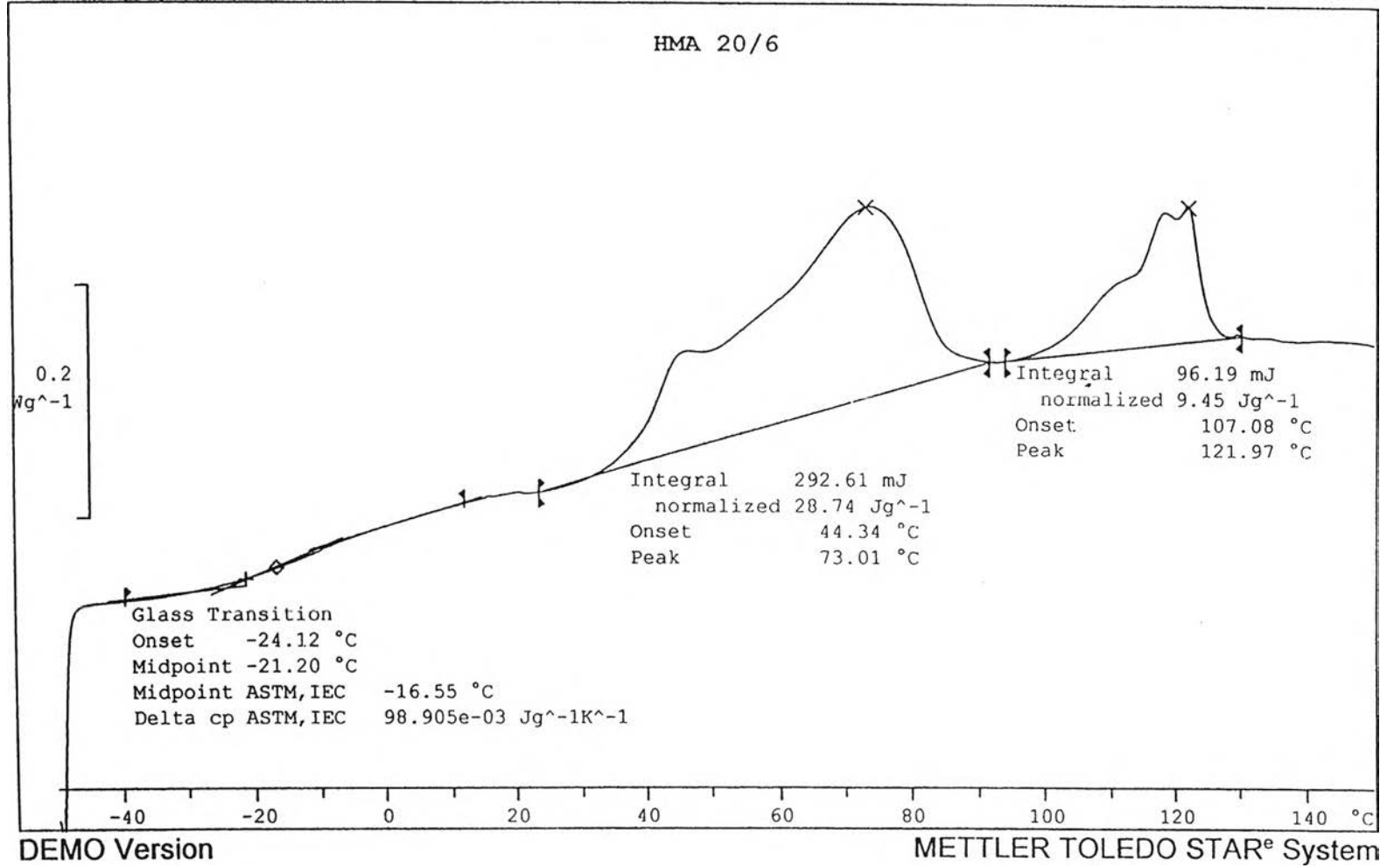


Figure B11 DSC thermogram of HMA20/6

^endo

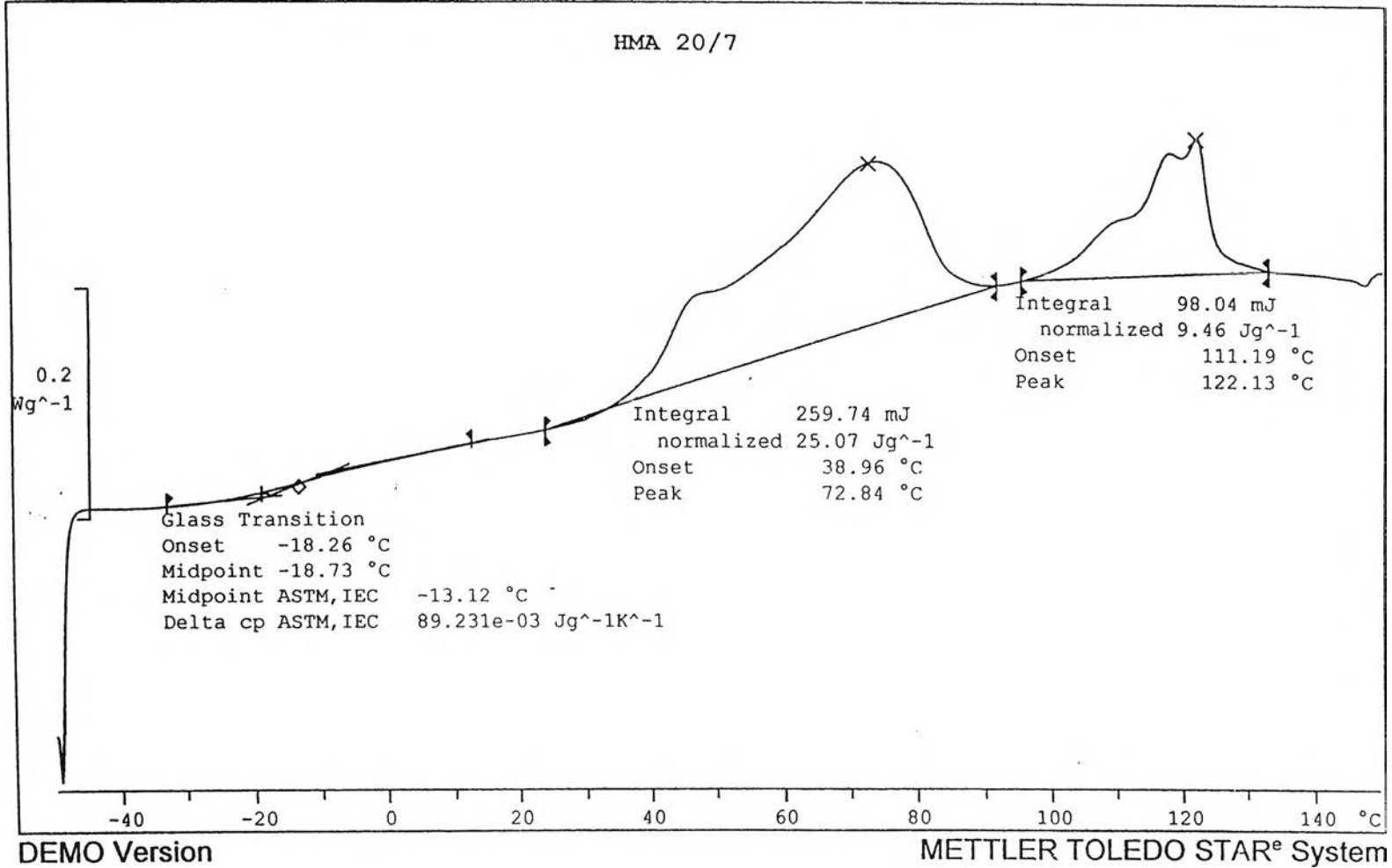
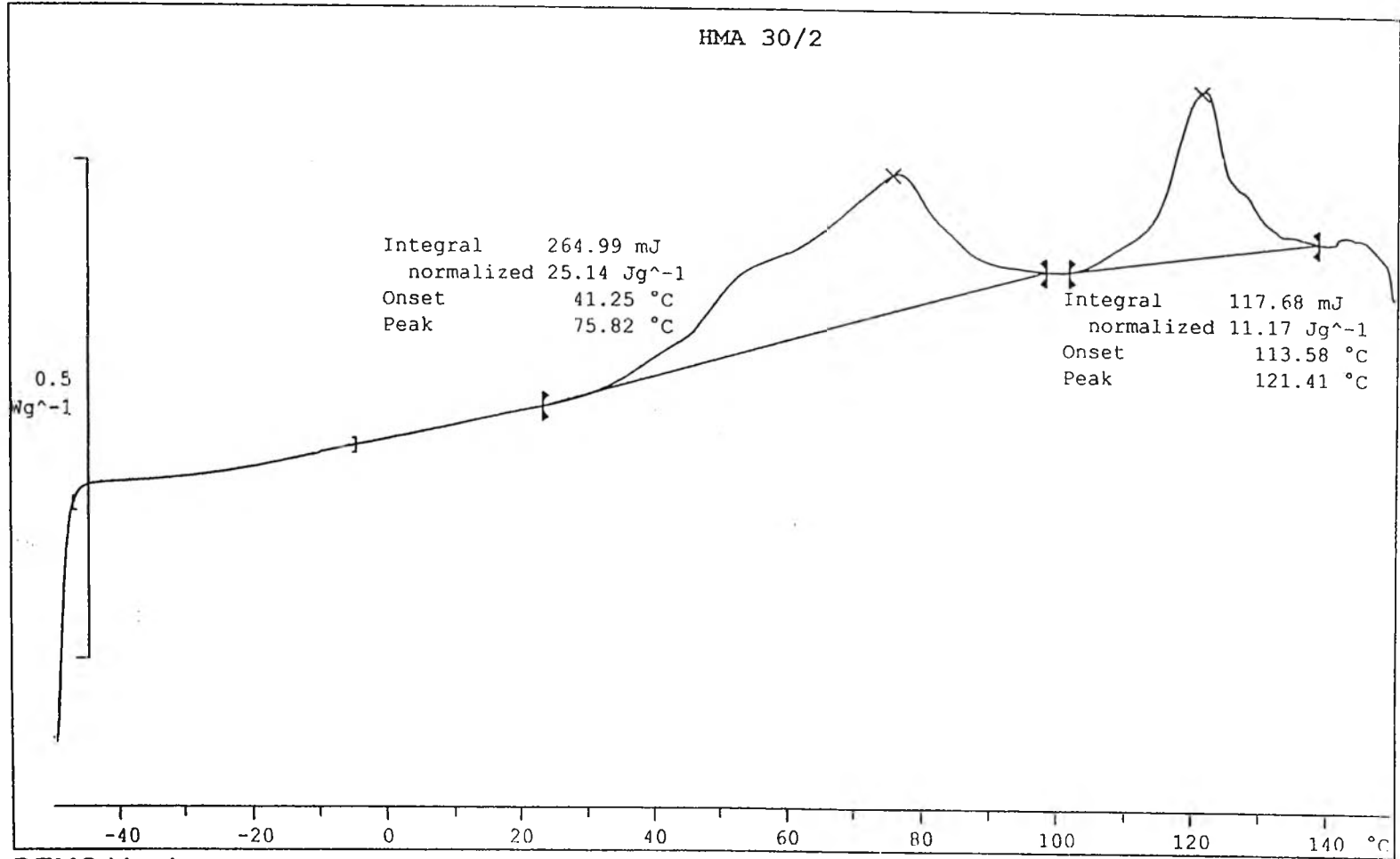


Figure B12 DSC thermogram of HMA20/7

^endo



DEMO Version

METTLER TOLEDO STAR^e System

Figure B13 DSC thermogram of HMA30/2

^endo

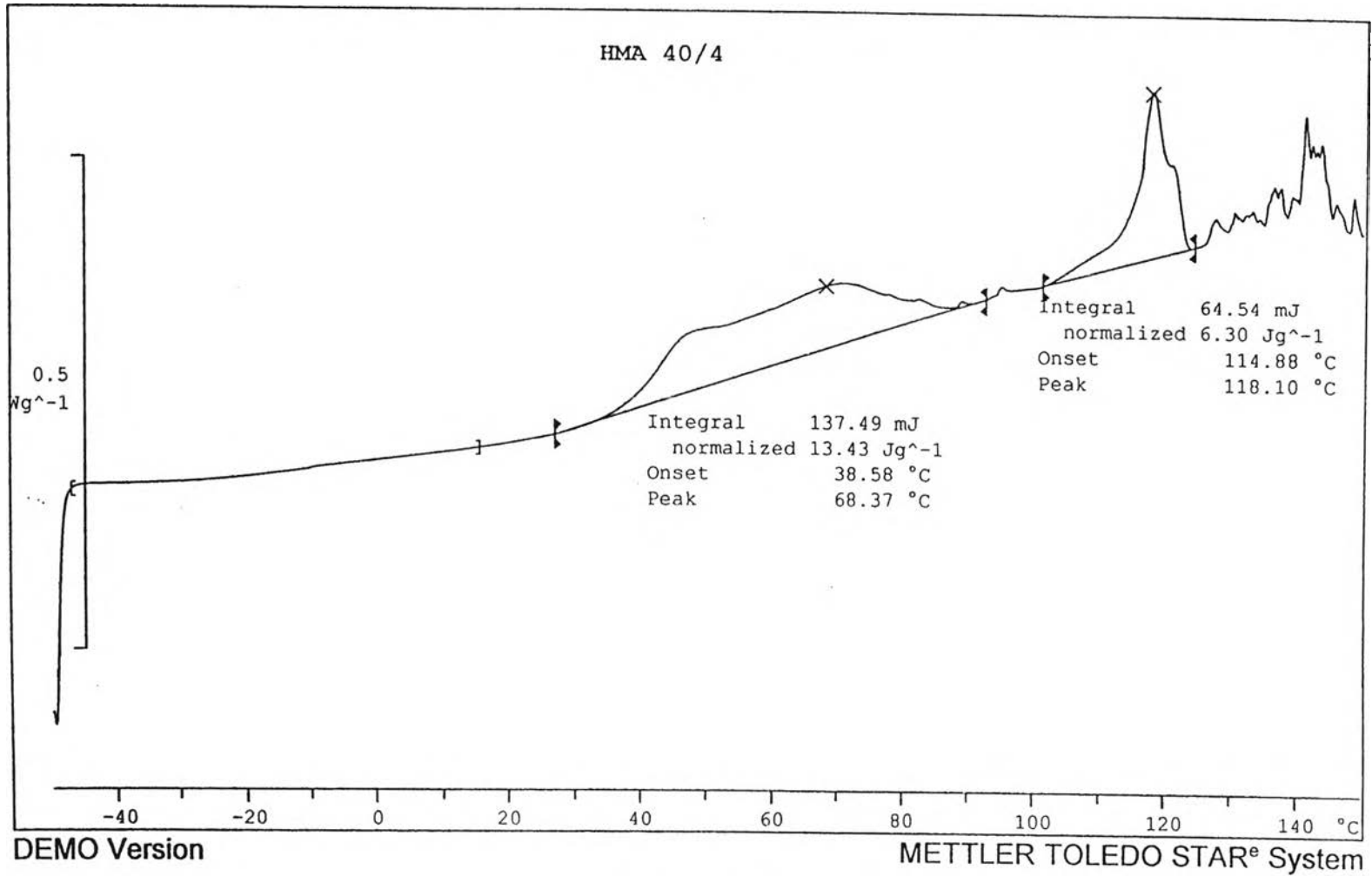


Figure B14 DSC thermogram of HMA40/4

Appendix C

- C. THE SEM MICROGRAPH OF INTERESTED EVA /MODIFIED STARCH-BASED HOT MELT ADESIVES WITH THEIR COMPOSITION INCLUDING EVA, ROSIN ESTER AND POLYETHYLENE WAX

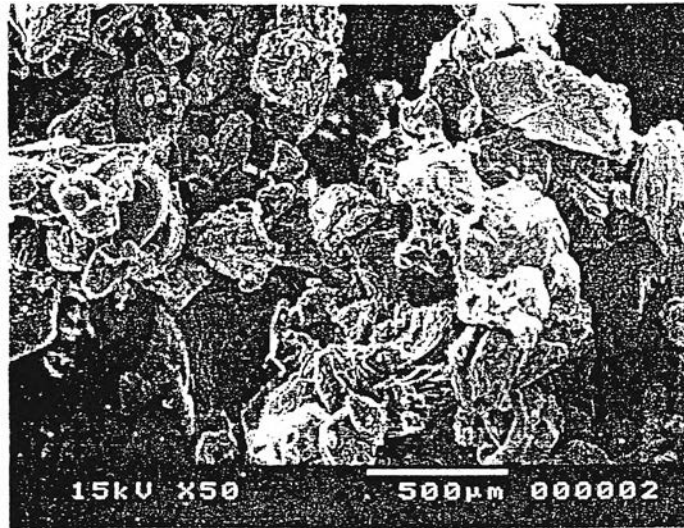


Figure C1 SEM micrograph of EVA (MV1055); 50X

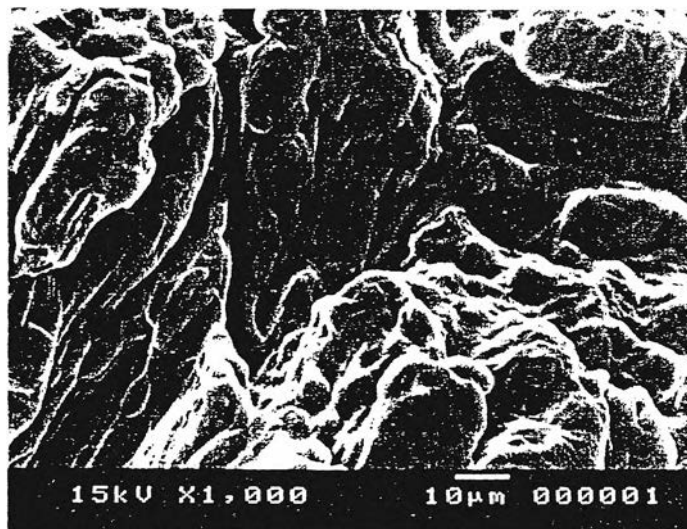


Figure C2 SEM micrograph of EVA (MV1055); 1,000X

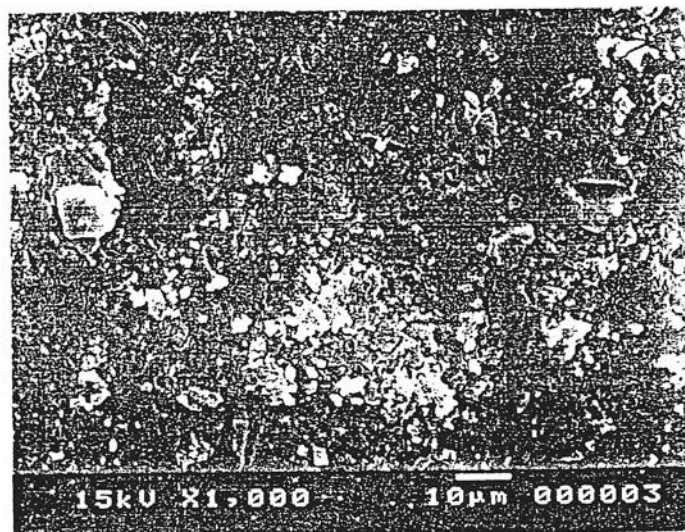


Figure C3 SEM micrograph of rosin; 1,000X

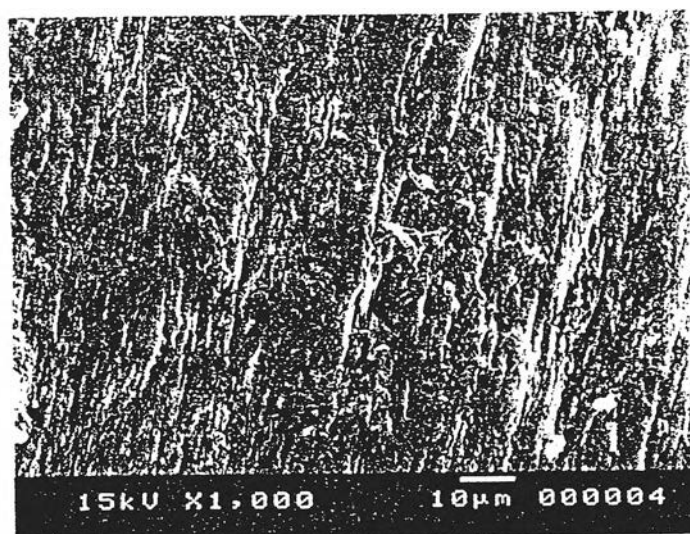


Figure C4 SEM micrograph of PE wax (PE300); 1,000X

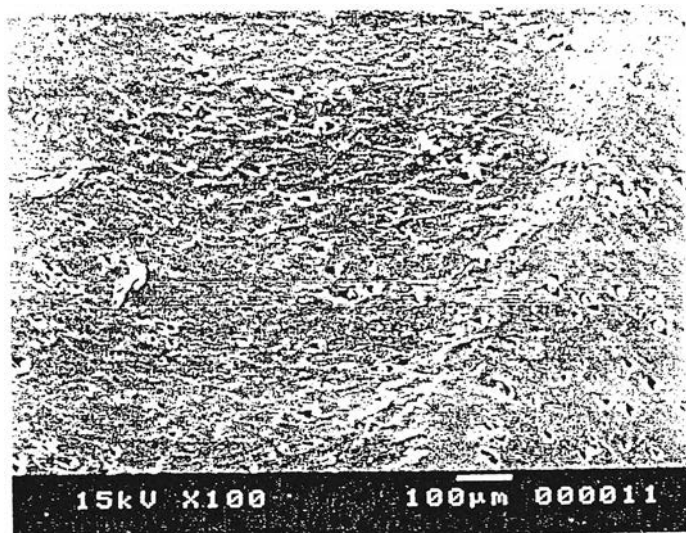


Figure C5 SEM micrograph of HMA10/2; 100X

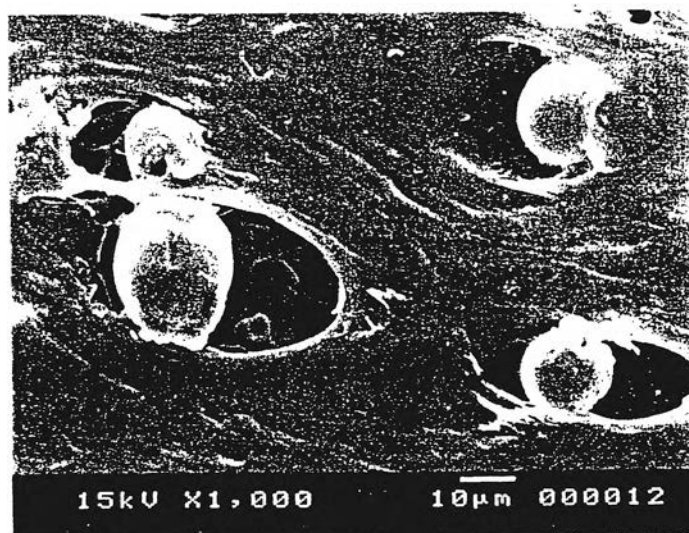


Figure C6 SEM micrograph of HMA10/2; 1,000X

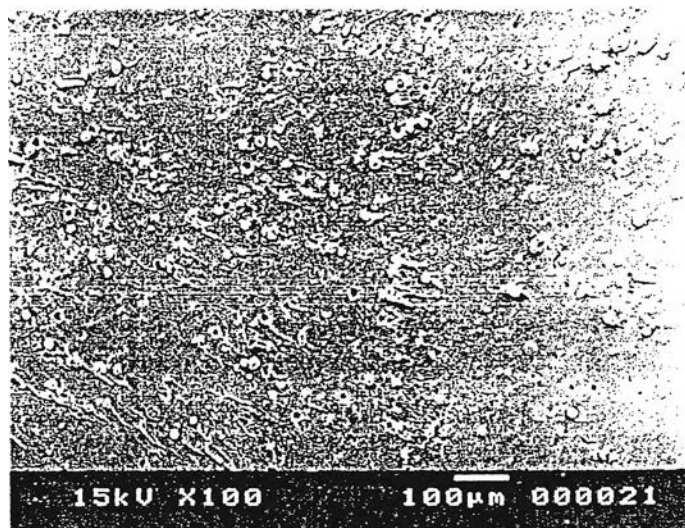


Figure C7 SEM micrograph of HMA10/3.; 100X

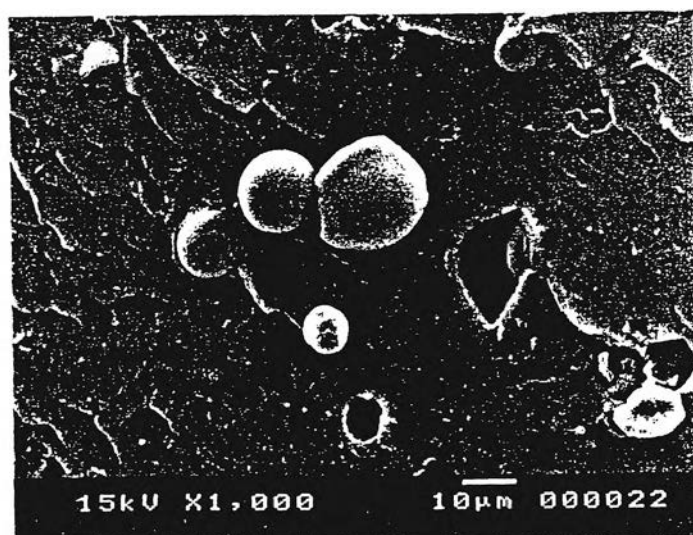


Figure C8 SEM micrograph of HMA10/3; 1,000X

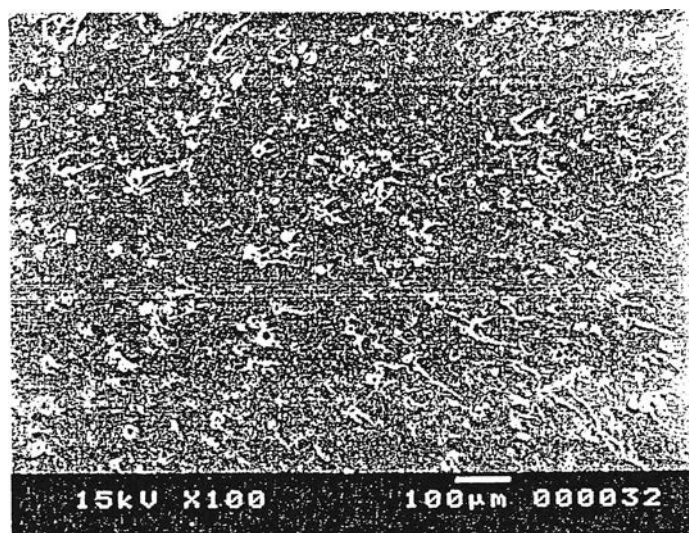


Figure C9 SEM micrograph of HMA10/4; 100X

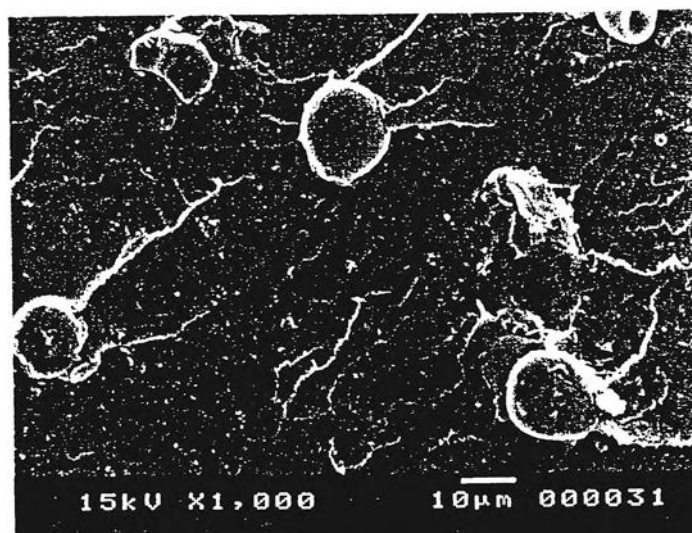


Figure C10 SEM micrograph of HMA10/4; 1,000X

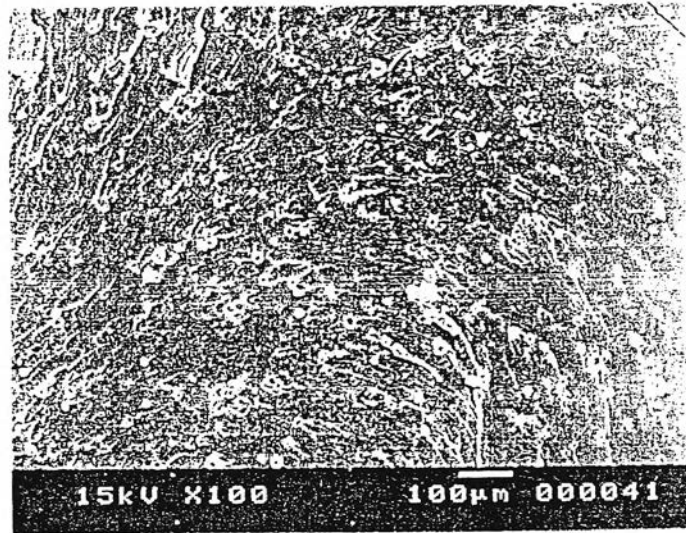


Figure C11 SEM micrograph of HMA10/6; 100X

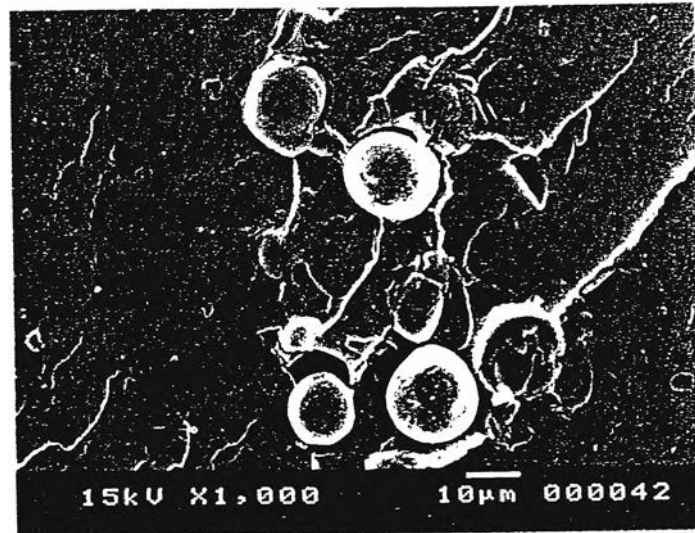


Figure C12 SEM micrograph of HMA10/6; 1,000X

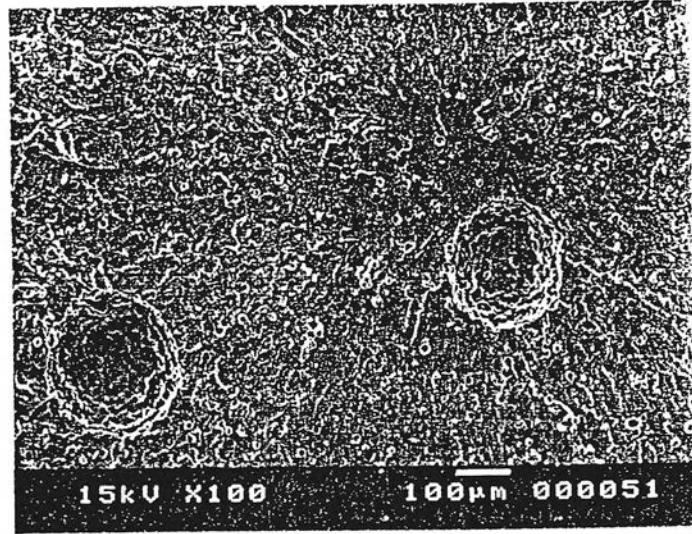


Figure C13 SEM micrograph of HMA20/2; 100X

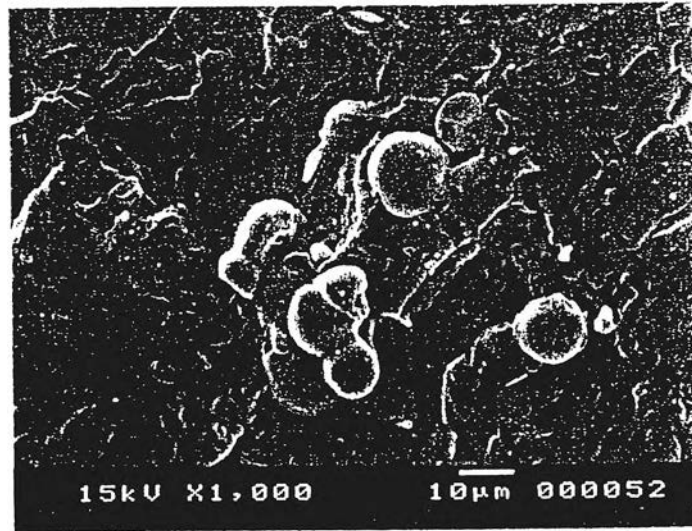


Figure C14 SEM micrograph of HMA20/2; 1,000X

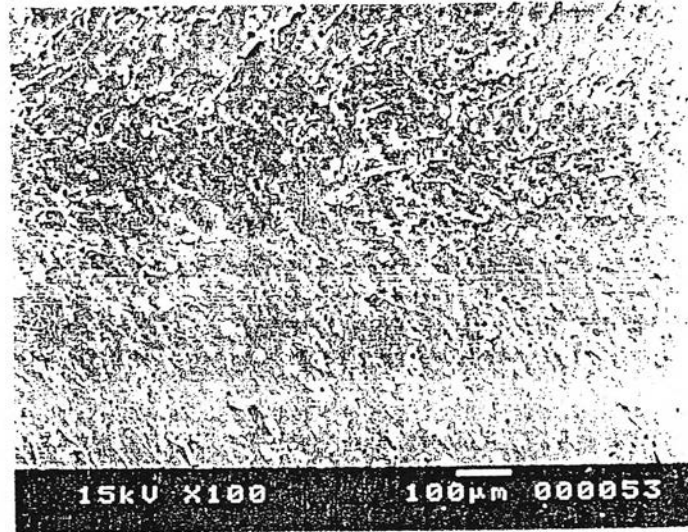


Figure C15 SEM micrograph of HMA20/3; 100X

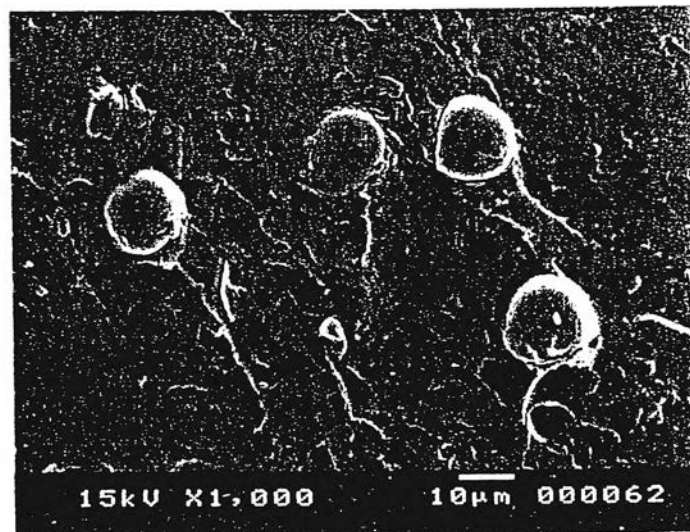


Figure C16 SEM micrograph of HMA20/3; 1,000X

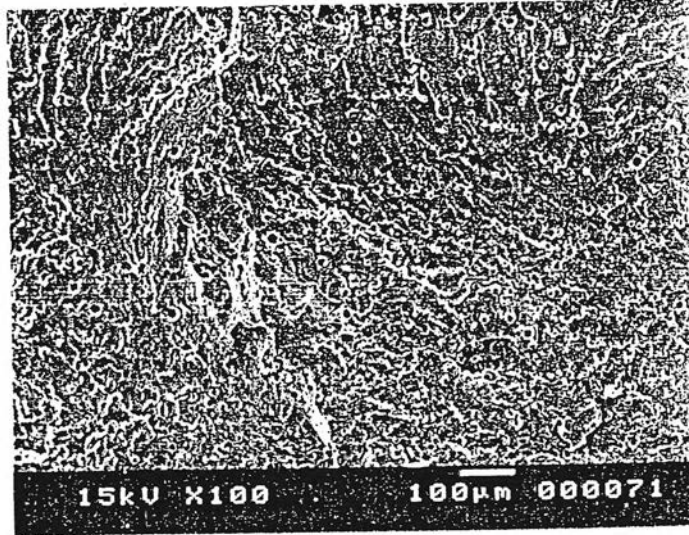


Figure C17 SEM micrograph of HMA20/4; 100X

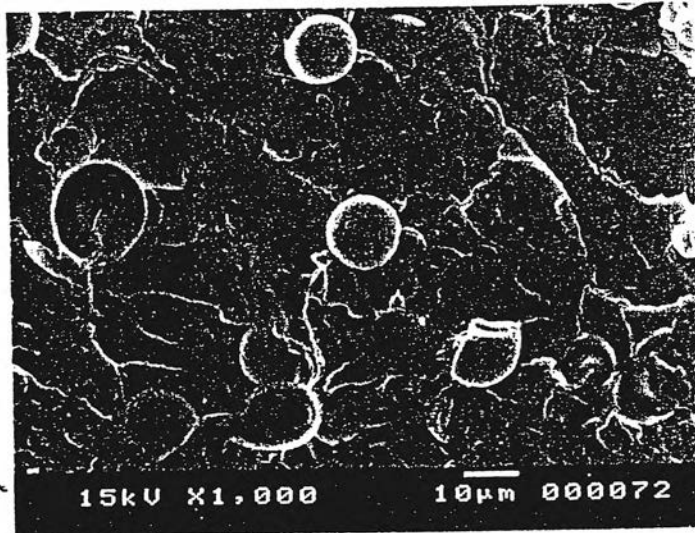


Figure C18 SEM micrograph of HMA20/4; 1,000X

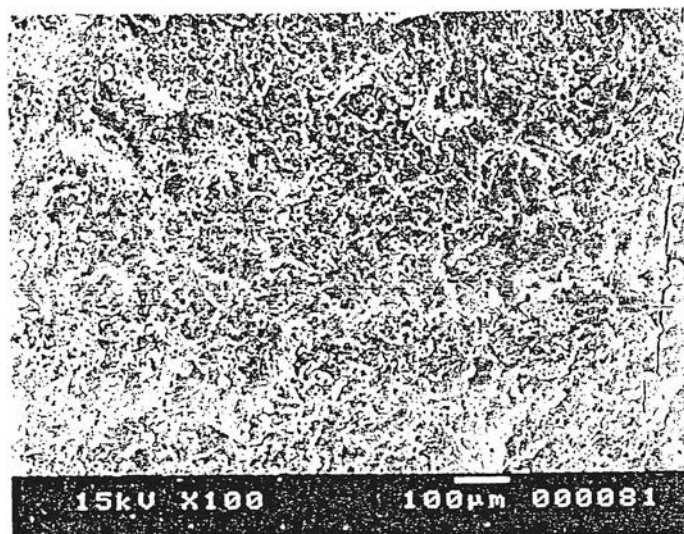


Figure C19 SEM micrograph of HMA20/5; 100X

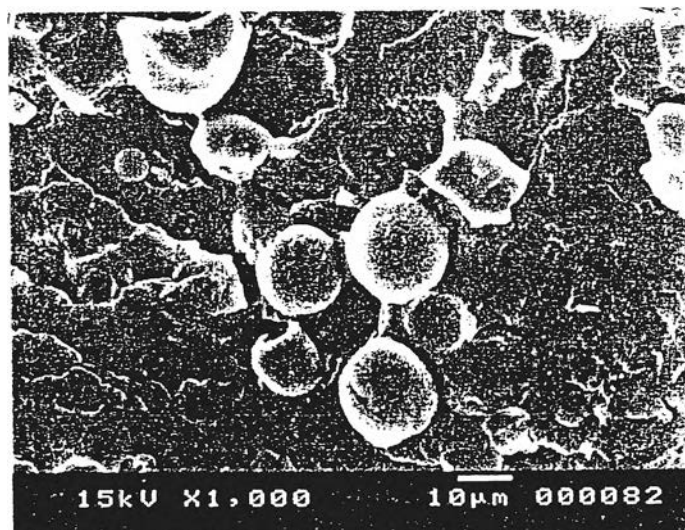


Figure C20 SEM micrograph of HMA20/5; 1,000X

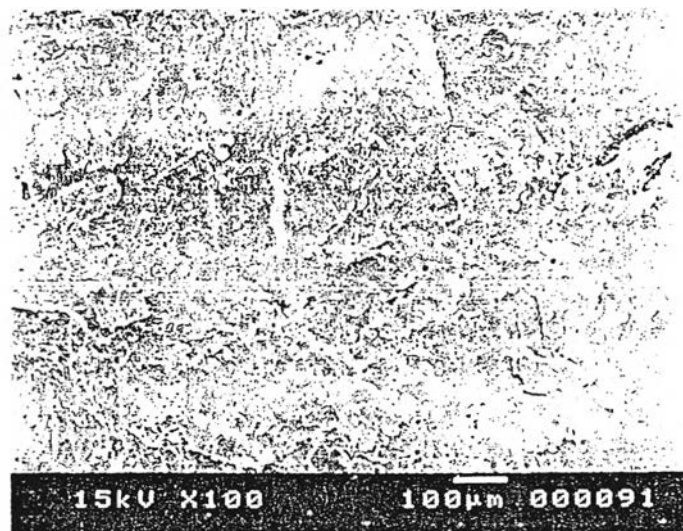


Figure C21 SEM micrograph of HMA20/6; 100X

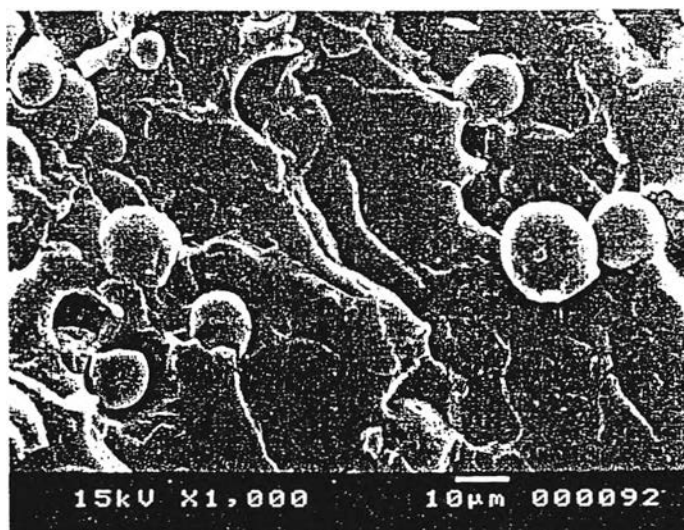


Figure C22 SEM micrograph of HMA20/6; 1,000X

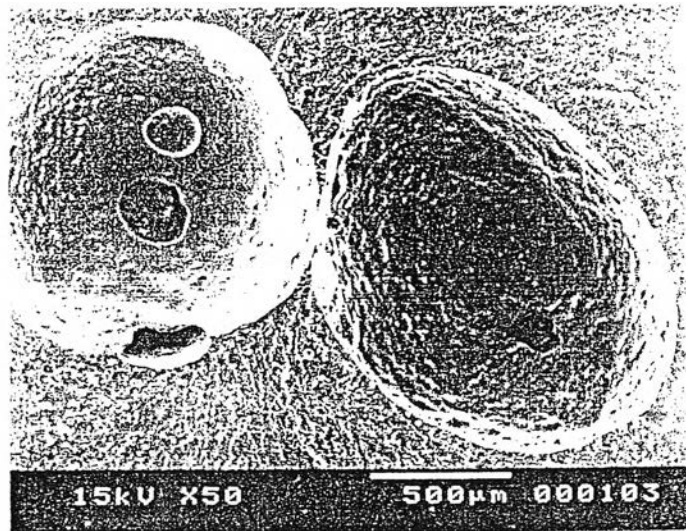


Figure C23 SEM micrograph of HMA40/3; 50X

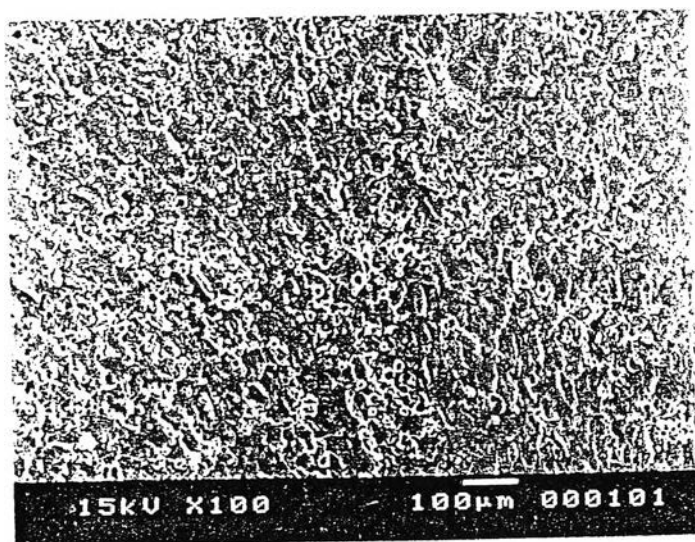


Figure C24 SEM micrograph of HMA40/3; 100X

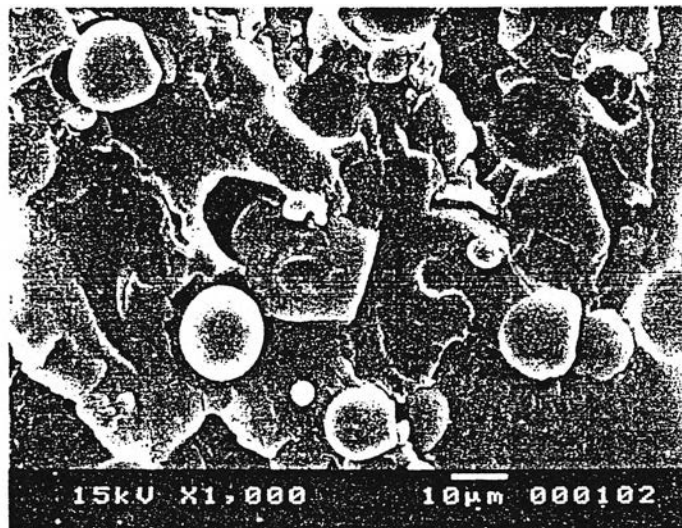


Figure C25 SEM micrograph of HMA40/3; 1,000X

Appendix D

- D. THE COST ESTIMATION OF EVA/MODIFIED STARCH BLENDS-BASED HOT MELT ADHESIVES MANUFACTURING

Table D1 The cost estimation of EVA/modified starch blends-based hot melt adhesives

Type	Part %	Raw material cost Baht / kg	Product cost Baht/Kg
EVA, MV1055	30	30	9
Modified starch	20	10	2
Rosin ester	40	40	16
PE wax, PE300	10	5	0.5
BHT	0.25	194	0.485
Operating cost		2	2
		TOTAL	29.985



VITA

Chestha Ninlahat was born on April 12, 1970 in Phuket, Thailand. He received Bachelor Degree of Science of Chemistry at Prince of Songkla University in 1992. He continued his Master of Science in Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University in 1998 and completed the program in 2002. He continued his job in Compounding (PXCD1) section, Auxiliary Department in Thai Petrochemical Industry Public Company Limited (TPI) since 1993. The present position is Section Manager of PXCD1 section.