American Injection Molding Institute

Plastics Technology & Engineering

Learning Objectives – Plastic Materials

1) Recognize the manner in which various polymers are polymerized and how chemical structure affects the properties of the polymers, such as environmental considerations, processability and overall physical performance.

2) Identify various methods used to study and report data on polymer rheology and relate them to the terms used to describe it, such as shear rate, shear stress, and viscosity

3) Recognize common commercial polymers as either semi-crystalline or amorphous (including elastomers) while being able to identify common characteristic differences between the classifications and analyze how the structural differences impact rheology, processing, and physical properties of a molded part.

4) Understand stress and strain relationships/graphs and the impact on the polymer properties. Recognize the practical aspects of viscoelastic behavior and other long-term time-temperature performance characteristics of a polymer, such as creep and stress relaxation in the solid state.

5) Identify the critical aspect of molecular weight and molecular weight distribution; their influence on both processing and end-use performance; identify practical methods for measuring molecular weight and how to interpret the results of these tests.

6) Identify the key uses of additives in modifying polymer properties and describe their impact on such items as shrinkage and warpage and while preventing other certain mechanisms that may compromise end-use polymer performance.

7) Interpret traditional material data sheets by analyzing the information and relating it to how the physical tests are performed, along with being able to convert units as needed.

8) Analyze and breakdown the various potential root causes of plastic part warpage due to variations in shrinkage, both volumetric and orientation induced.

Document Revisions:

20220422 - DH - Added questions 113, 114, 115 to evaluate ESC vs Chem Attack per LO1 rev 20211112; reviewed in review 7; updated point total to 270; no change in cut score after workshop completed

20211112 - DH - Updated LO1 to include reference to environmental issues per the AB meeting for 2021

20211011 - DH - Question numbering at the top was incorrect due to formula error

20210831 - DH - Updated rev to match most recent exam rev of 20210831

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20210609 - DH - Updated spreadsheet to reflect new Q67 and exam version 20210609

20200806 - DH - Added questions 109-111 for elastomers to match exam 20200423, updated LO3 to include elastomers along with review 6 (see log in the LO excel file)

20190904 - mR - made additional notes under revision log

20190904 - mR - missed correction of 117

20190904 - mR - Removed #5 from question 5, LO #3 Updated the numbering 102-118

20190606 - DH - Combined open book and closed book into closed book only; added sub question to 107 which added 2 points

20190213 - DH - Added unit conversion exam question and updated LO 7 to include unit conversion

REV 20221116

Learning Objectives – Mold Design

1) Analyze mold cooling systems and components and identify ways to improve the uniformity and efficiency of removing heat from the molded part.

2) Recognize the primary mold components, and recall key considerations, for ejecting plastic parts and runner systems.

3) Identify various machining operations/machines, mold types and recall the purpose and key considerations for each of the five primary mold systems and associated components and design considerations.

4) Recognize how complex melt flow conditions develop during molding and describe the interdependency between those material properties, and the injection process and the design of the melt delivery system.

5) Recall and explain key plastic shrink and warp considerations.

6) Recall the various gate styles and explain the influence that gating location(s) have on part quality and manufacturing efficiency

7) Analyze the melt delivery system of injection molds and evaluate how its design impacts the molded part quality and manufacturing efficiency.

8) Analyze and solve engineering, strength of material, problems related to the structural integrity of injection mold plates and components.

9) Identify the primary elements of a mold vent, analyze mold design and plastic flow to identify where vents should be placed, and recognize the relationship between a plastic materials classification, viscosity, and its impact on the recommended vent depth.

10) Recognize the importance of designing for assembly and recall key considerations for preventing component installation errors.

Documentation Revisions

20220721 - DH - Updated point value for Q96 from 4 down to 2 to match exam version 20220419

20211007 - DR - Updated LO9 to include identifying locations and viscosities impact on depth

20210105 - DH - Updated LO3 to include machining ops/machines; removed bonus question and included in regular scoring

20201002 - DH - Additional changes to same rev =see notes in file or exam version; point total updated to 258

20201002 - DH - Removed Q39 & 40 (part of Q38 now), & 42 (combined with 31); adjusted point totals for removed questions and other changes based on psychometrics Y:\1-CertificatePrograms\PTE\ANSI_Accreditation\Psychometrics\Human_Measurements\2020\MDE\Questions-for-Revie

20200123 - DR - Added Q's 91 & 96 - these are cooling questions.

20191022 - DH - Removed column for LO9 since only has 8 now

20191022 - DH - Removed Q48, 49, 106 (12 pts total) related to Mold vs Machine; moving to IM course per AB meeting

20191007 - DH - Q93 (previously 102) was updated per recommendation of AB; added 2 sub-questions also

20190904 - mR - Removed Duplicate 102 from LO# 1 and deleted extra rows from open book

20190403 - DH - Updated to be closed book only and per exam revision 20190403 points and questions

20190312 - mR - Deleted questions 6,14,59,74,75,82, question 92 reworded and changed to multiple choice, question98 reworded, question100 a,b changed to fill in the blank, question102 changed to multiple choice, question 111 specify 3

20181002 - mR - Updated total scores for closed/open book20180821: CB - removed bonus points from q120 and converted to standard 2pt question; OB - removed Q4 (2pts) per JB and replaced with Q8 (6pts+2 bonus); removed Q8 due to duplicate style question with Q7; updated points and relationships to exam questions

20190312 - MR - Deleted questions 6,14,59,74,75,82 Question 92 changed to multiple choice, question 98 reworded, question 100 a,b changed to fill in blank, question 102 changed to multiple choice, question 111 changed to specify 3.

REV 20221116

Learning Objectives – Injection Molding

1) Evaluate current industry processing standards and determine what practices are beneficial and recognize the impact that the process inputs have on the process outputs and molded part

2) Demonstrate a recognition of and application for alternate methods of injection molding

3) Recognize commonly used terminology and componentry utilized in injection molding

4) Evaluate and determine if a given molding machine is adequate for a specific part and mold

5) Determine how to properly manage, prepare, and cool plastic materials throughout the injection molding process

6) Analyze the phases of the injection molding process and determine the appropriate machine settings are for each phase

7) Analyze process documentation and historical run data in order to strategically troubleshoot the molding process

8) Analyze graphical representations of the molding process for information and troubleshooting purposes

9) Apply Flow Grouping Methodology and utilize it in a scientific manner to optimize process control

10) Analyze the impact that the material, mold design, and part design have on the molding process and the molded part quality

Document Revision:

20220104 - DH - Updated point total for Q36 to reflect change to exam rev 20220104

20211026 - DH - Updated to move Q66 as part of Q124; all other numbers shifted; accordingly, point total stayed the same

20210126 - DH - Removed Q37 as it needs further studies for clarification and updated point total

20210108 - DH - Updated spreadsheet with changes to exam version 20210108; see notes in spreadsheet or exam data card

20200629 - DH - Updated point value for Q14 and 112; no major rev since course not held since the new course and exam version

20200629 - DH - LO 10 from MDE is already covered in LO 4 in IM, no new LO added; reworded LO 2; realigned lecture sections, online reviews, and exam questions with new course layout after Bozzelli no longer teaching; course was revised after his departure with same LO's in mind; exam revised accordingly with questions being removed and new ones added per the newer course content; added LO10; modified LO1 to include the analysis of process settings

Learning Objectives – Part Design

1) Design injection molded plastic parts for manufacturability considering the complex interdependencies of the design, the polymer material, mold, and the injection molding process.

2) Interpret mechanical polymer material data including complex viscoelastic, non-linear and environment dependent properties, as applied to injection molded plastic parts

3) Identify appropriate plastic materials for a defined application considering both performance and cost requirements

4) Interpret and apply Plastic Part Design Guidelines considering manufacturability, performance and stability of the injection molded plastic part

5) Evaluate and recommend plastic part assembly methods

6) Design plastic parts for structural applications considering the complex viscoelastic, non-linear and temperature dependent properties of plastic materials

7) Evaluate and recommend decoration options for injection molded plastic parts

8) Interpret, critique, and analyze injection molding simulation results of injection molded plastic parts

Document Revisions:

20221031 - DH - New cut score 75%, point total same, question LO connection to exam the same

20220511 - DH - Updated per exam rev 20220511•20190709: DH - Removed snap fit Q48, added Q49-52 for new snapfit content; removed Q97, added Q100-102; converted to all Closed Book

20190419 - DH - Updated per exam rev 20190419 by removing CB Q22