Worksheets

3D Printing vs Transfer Molding Comparative Analysis Report Rubric

Name _____

Students are completing a comparative analysis to test the physical properties of a given material using two different devices: a 3D printer & transfer mold machine. In technical terms: students using an extruder will make their own filaments and 3D print Izod Impact Resistance Bars and Tensile Bars to test the material & production-process strength against the same material/shaped bar for Izod & Tensile Bars made using a transfer mold machine. Students will complete a comparative analysis of two tests: Izod Impact Resistance ASTM D-256 & Tensile Strength ASTM D-638M. Students will evaluate their data to **provide a solution to a real-world problem** in industry/society that they determine to answer. Students will need to conduct research to determine a real-world problem. Students' data must be used to support their claim to their answer of the real-world problem **based on prioritized criteria** and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Requirement	Teacher Check for Completion
Report contains an Abstract that details the basics of the tests performed in relation to the real-world problem identified to be studied by the student.	/4
Report has: ● lab title , ● date of tests, ● ASTM's, ● Materials Tested, ● Form of material, ● testing conditions	/1
Data tables of collected data for both tests, all proper labels and units.	/10

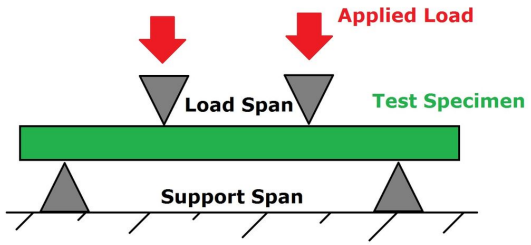
Calculations for collected data for both tests, all proper labels and units with work shown.	/10
Final Results of data & calculations. What trends are identified? What does the data say? No inferences only facts about the data here.	/5
Conclusion: Based on data evidence collected by the student and **researched polymer production criteria** such as but not limited to: cost, availability, reliability, safety, aesthetics, and environmental aspects; what recommendation is made to solve the real-world problem identified? ● Recommendation is based on **prioritized criteria and trade-offs** that are specifically selected for the real-world problem identified. (Why did you prioritize the criteria the way you did?)	/20
Works cited page. In-text citations used for references when referring to researched polymer production criteria related to the identified real-world problem in conclusion.	/10
TOTAL	/60

<u>Teachers without a mold machine, Tensile & Impact Testers</u>

Optional 3-point Bend Test & different directionally printed 3-D Bars

Note This is an optional testing procedure for teachers that do not have access to tensile or impact testers. This test can be set up using regular high school science lab equipment and student data can be used in a similar manner to support their reasoning in answering their real-world problem. Additionally, students could test 3-D printed bars that are printed in different planes (horizontal vs vertical) instead of comparing molded bars to 3-D printed bars. This would allow for a comparison similar to the type of comparison detailed in the main lesson.

3-point Bend Test (modified from ASTM standards and adopted to fit the needs of a high school lab)
Image courtesy of http://www.instructables.com/id/TestrBot-The-300-Universal-Test-Machine/



This is the general set-up of a 3-point bend test. In a high school lab this could be made using a common set of masses and some blocks of wood/textbooks. The wood/textbooks are the support span and the set of masses can be used as the applied load. Students can selected a set amount of load to be applied for a given amount of time and measure the deflection using a ruler in the bend of the test specimen. The bend can be measured at set intervals during the testing time. Students could also measure the rebound of the material after the applied load is removed, measuring to see if the test specimen comes back to initial position or not. From here a percent deformation could be calculated. Ideally only one mass and one test should be performed per test specimen. In other words, students should not use the same test specimen to test 4 different sets of masses on. Students could use this procedure to compare horizontally vs vertically printed 3-D bars and determine flexile properties for each bar along with percent deformation under constant load.