AUTOMOTIVE HEADLIGHT LENS:

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BACKGROUND

One of the most important parts on an automobile is the headlight. A typical automotive headlight has a number of components that have one or more functions. The most noticeable part of the headlight is the lens. The lens is probably one of the most important components on the headlight because it has several important functions. The project is to use the Cambridge Engineering Software selector (CES) software to investigate materials that can be used for the lens of an automotive headlight and choose the best material for the application.

OBJECTIVE

The main objective of this investigation is to find a material for the lens that will minimize the cost of production and complies with the engineering requirements.

REQUIREMENTS

The requirements for the lens of a headlight are as follows

- Must have good optical property (transparent)
- It has to be strong (minimum elastic modulus and high fracture toughness)[?]
- Needs to have the ability to be shaped into complicated 3-D shapes
- Good resistance to mild acids and petroleum products
- Good wear resistance to resist scratches (hardness)
- Needs to be unaffected by UV-rays
- Minimum cost

This project will require the use of levels 1+2 of the CES. Students are advised to use the Limit stage and several Graph stages in the CES to eliminate materials that do not meet the requirements. Rank the most important constraints that the part must meet in order to function properly and safely. Start with the most important constraint and go to the next.

NOTES FOR INSTRUCTOR

Using CES selector open a new file that will use levels 1+2. Press the *Select* button to start the selection process. From the *New Project* box select level 2, and then select *material* universe. The **Result** box in the lower left corner of the screen will display all 67 materials pass the requirements since these have not been included yet. From the **Selection Criteria** box select a button for a N*ew Stage*. Choose *Limit Stage*. From the *Limit Stage* select *Optical Property* requirements, from the options select "optical property". Click *apply* at the top of the screen. This stage eliminates 60 materials from the **Result** box that do not satisfy requirements, i.e. do not have optical properties. Figure 1, in Appendix A, show what the limit stage looks like and shows the materials that pass this *Limit Stage* in the **Result** box.

To construct a Graph Stage proceed as follows. From the **Selection Criteria** box select *Graph Stage*. From the *New Graph Stage Wizard* select *Optical Properties* form the *Category* selection and select *optically transparent* from the *Attribute* selection. Select Y-axis and select *General Properties* from the *Category* selection and select *price* from the *Attribute* selection. A graph with all of the materials in the data base will be displayed that ranks each material relative to its optical property and price. *Selection Box* tool will be used to select materials that are desired, i.e. have optical properties and the lowest price. All other materials that have not been selected by the *Selection Box* tool will be eliminated from the **Result** box after this stage is applied to the selection precess. Repeat Graph Stage but with the following parameters: a) *Transparency vs. Fracture Toughness*, b) *Transparency vs. Young's modulus*, c) and *Transparency vs. Mouldability*. Figure 2, in Appendix A, shows *Graph Stage* where parameters are Transparency vs. Price. It can be seen from Figure 2 that the materials that had the best optical quality and the lowest price were selected with the *Selection Box* tool. It can be seen from Figure 2 that materials that passed this stage are: silica glass, polycarbonate, cellulose polymers, borosilicate glass, polymethyl methacrylate, and polystyrene.

After applying all stages to the selection process only 1 material has successfully passed all of the stages. Polymethyl methacrylate was the best choice for the material to be used in the lens of a car headlight. Out of all materials that were transparent it had

third highest fracture toughness, second highest Young’s modulus, one of the best mouldability properties, and it had the lowest cost.

APPENIX A

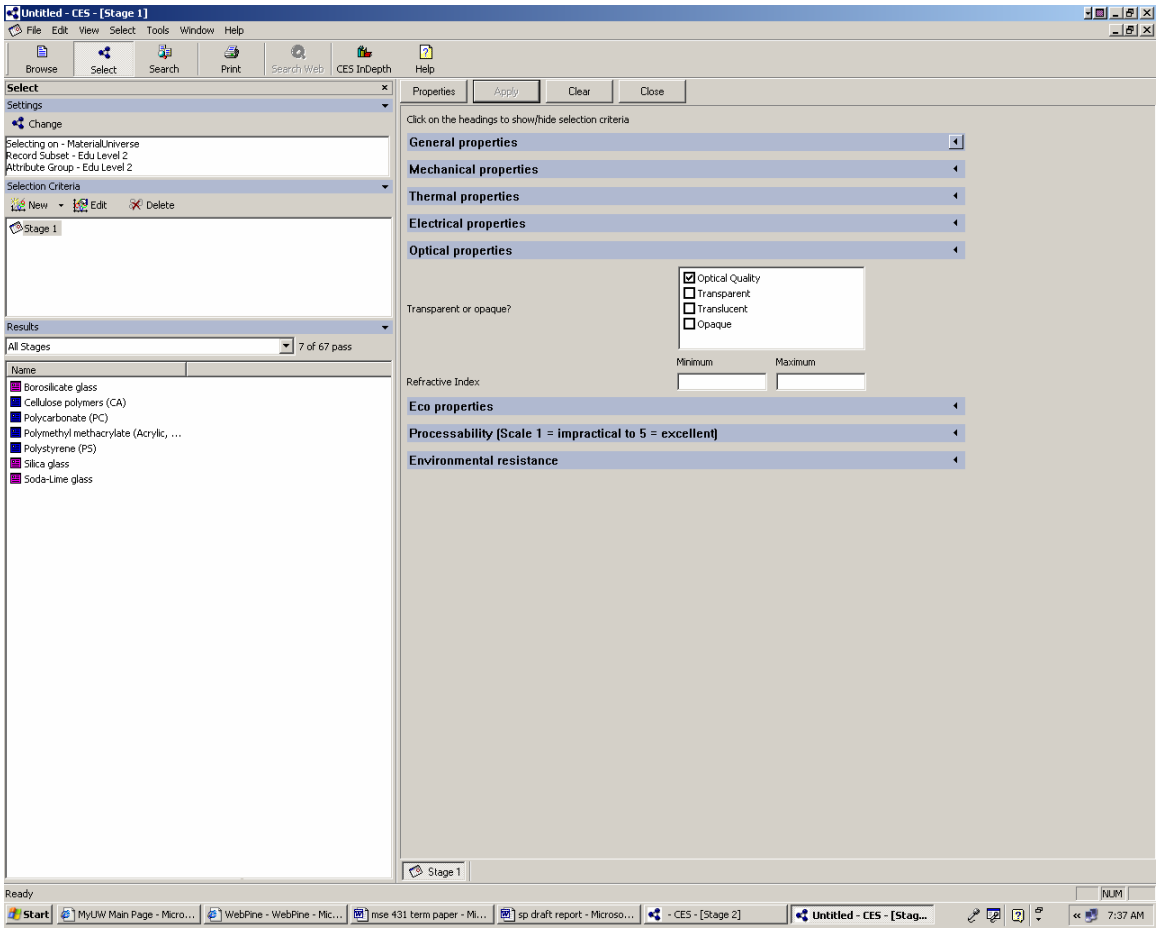

Figure 1. Limit stage selections and the results after this stage is applied to the selection process.

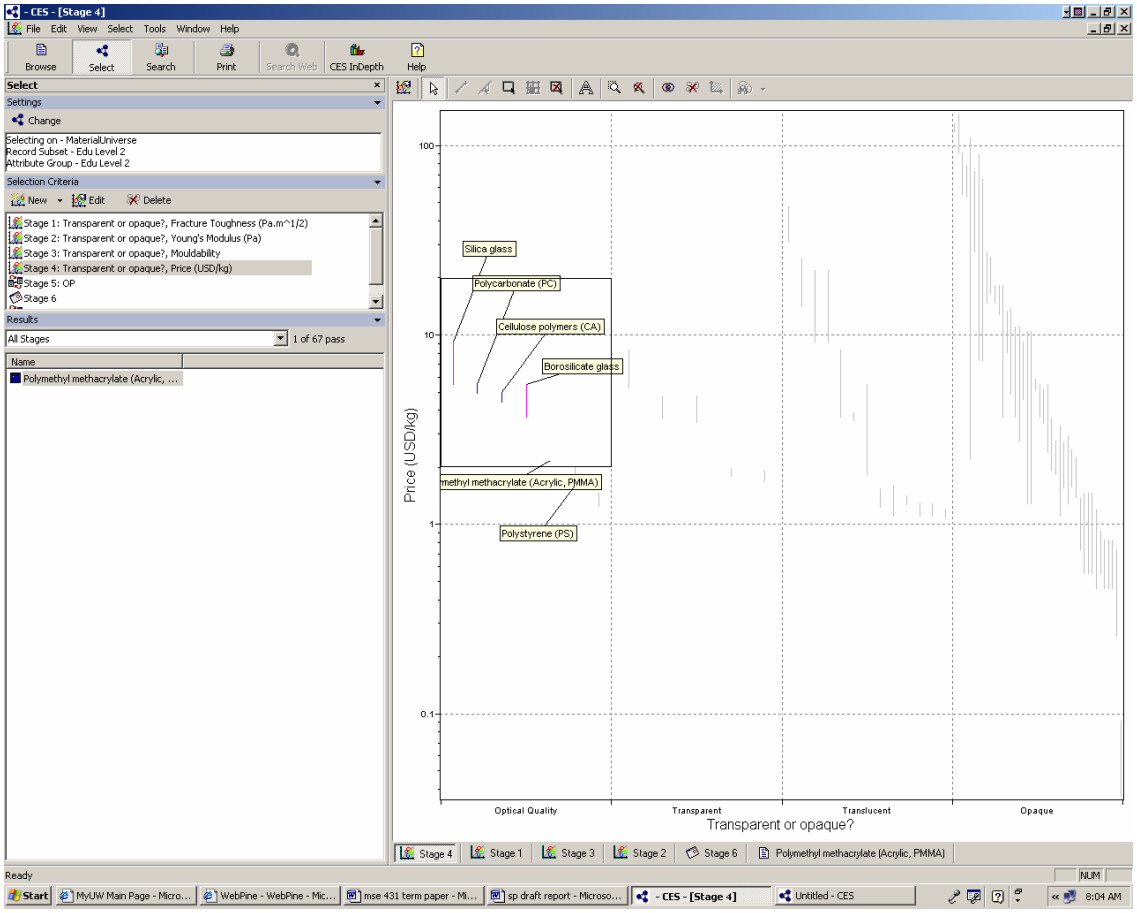

Figure 2. Graph Stage of price and optical properties showing selected materials in the selection box, and the result displaying one material that passes all stages.