Musical Instrument Adhesives

**Description of Activity**

* A study of Protein Colloid, Polyvinyl Acetate (Aliphatic Resin), Polyurethane Adhesive and Cyanoacrylate Adhesives (Hide, Elmer’s, Gorilla and Crazy Glues)
* Woodworking in general and instrument manufacturing in specific make great use of a variety of adhesives. Knowing what adhesive to use for a given application is important for project success.
* Chemical curing adhesives reach their cured or crosslink by a series of chemical reactions (polyaddition, polycondensation or polymerization) that occur internally between the monomers
* Physical curing adhesives are those adhesives that contain the polymer already formed, but they need an energy source (heat, pressure, etc.) to produce the adhesion and curing process
* This activity will be presented to students in Wood 2/Advanced Wood grades 10 -12.

**Learning Objectives:**

1. Students will give examples of monomers, pre-polymers and polymers.
2. Students will research and define adhesive types and characteristics.
3. Students will apply the research to complete a comparison matrix
4. Student groups will prepare and apply an assigned adhesive to affix a fret board facsimile to a guitar neck facsimile.
5. Student groups will compare and contrast the separation ability of the four assigned adhesives
6. Students will measure to 1/16ths of an inch.

**Standards:**

HS-PS1-4.

Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS2-6.

Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

CCSS.Math.Content.HSG.MG.A.1

Use geometric shapes, their measures, and their properties to describe objects

CCSS.ELA-Literacy.RST.11-12.7

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

**Materials Required:**

* A computer lab
* Long wood scraps
* Wood Glue
* Super Glue
* Hide Glue
* Gorilla Glue
* Long elastic straps
* Digital camera
* A variety of separation tools
* Hot air gun, soaking tank, steam box, hot wire cutter etc…
* Video camera or web cam etc.

**Safety:**

**safetys:**

* Safety Glasses
* Leather work gloves
* Chemical proof work gloves

**References:**

* <http://www.permabond.com/blog/2011/10/24/glossary-cure-time-terms/>
* <https://en.wikipedia.org/wiki/Wood_glue#See_also>
* Adhesive specific Material Safety Data Sheets (MSDS)

**Activity:**

**RESEARCH**

In the computer lab research and define the following terms:

* Shelf life -
* Fixture time –
* Pot life –
* Open time –
* On part life –
* Handling time –
* Working Strength –
* Full cure time –

**COMPLETE THE COMPARISON MATRIX**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Adhesive/  Technical  name | Common  Name | Physical  Properties | Applications | Advantages | Disadvantages | Material  Hazards | Safety  Precautions |
| Urea Formaldehyde |  |  |  |  |  |  |  |
| Protein  Colloid |  |  |  |  |  |  |  |
| Resorcinol-  Formaldehyde |  |  |  |  |  |  |  |
| Phenol Forma-ldehyde Resin |  |  |  |  |  |  |  |
| Polyurethane  Adhesive |  |  |  |  |  |  |  |
| Epoxy  Adhesive |  |  |  |  |  |  |  |
| Cyanoacrylate  Adhesive |  |  |  |  |  |  |  |
| Casein  Glue |  |  |  |  |  |  |  |
| Polyvinyl  Acetate |  |  |  |  |  |  |  |
|  | Contact  Cement |  |  |  |  |  |  |
|  | Hot  Glue |  |  |  |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Adhesive/  Technical name | Shelf  Life | Open  Time | Pot  Life | Handling  Time | Full Cure  Time |
| Protein  Colloid |  |  |  |  |  |
| Polyurethane  Adhesive |  |  |  |  |  |
| Cyanoacrylate  Adhesive |  |  |  |  |  |
| Polyvinyl  Acetate |  |  |  |  |  |
| Epoxy  Adhesive |  |  |  |  |  |

Best method for dismantling the assigned glue joint:

|  |
| --- |
|  |

**HANDS-ON – Assign the following roles: Assembly and Demolition technicians, Photographer, Videographer, Recorder, and Reporter.**

* From the long thin wood scrap bin obtain 2 pieces of hardwood, one 24-7/16 x 2-3/16 x 11/16. The other 24-7/16 x 2-3/16 x 5/16.
* Prepare the surface and/or adhesive and glue the “fret board” to the “neck”.
* When fully cured, remove the “fret board” as cleanly as possible.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Inches Separated | Time Elapsed | Effort Required |
| Removal  Method  1 |  |  |  |
| Removal  Method  2 |  |  |  |
| Removal  Method  3 |  |  |  |
| Removal  Method  4 |  |  |  |

* The group videographer will record your efforts from start to finish.
* The group recorder will note significant events (successes, difficulties etc…).
* The group photographer will document the entire process, glue up to removal.
* Prepare a technical report no longer than 5:00 minutes and no shorter than 4:55 minutes with the presentation software of your choice. Be sure to include charts, graphs, technical illustrations, digital photos and video clips.
* The group reporter will present your findings to your classmates. However, each member must present for at least 30 seconds.

**Quiz:**

1. Protein Colloid (hide glue) adhesive is used in…
2. Lutherie
3. Piano Repair
4. Antique Restoration
5. All of the above
6. Epoxy adhesive consists of…

A. a resin

B. a hardener

C. a Thixotropic polymer layer

D. A and B are correct

1. Polyvinyl Acetate…

A. was discovered in the 1880’s

B. was used extensively to make tri-corner hats during the American Revolution

C. is an aliphatic rubber synthetic polymer

D. is a long branched, cross chained monomeric compound

1. Polyurethane adhesives perform best with \_\_\_\_\_ present while drying’
2. Water
3. Heat
4. Pressure
5. A and C are correct
6. Cyanoacrylate (CA) adhesive dries to a \_\_\_\_\_ finish on wood.
7. Grayish
8. Yellowish
9. Blueish
10. Glossy
11. Resorcinol formaldehyde resists…
12. Salt water
13. Mild Acid
14. Mold and fungus
15. All of the above
16. Phenol formaldehyde is used to make plywood and is cured with…

A. Heat and pressure

B. Moisture and pressure

C. Light and pressure

D. Complete darkness

1. Casein based glues fell out of favor because…

A. Casein is needed for artist paint production since the 1960’s

B. It is susceptible to microbial degradation

C. Casein is needed for cheese production

D. Casein is needed for plastic production

1. Hide glue must be dissolved in water and…
2. Stirred constantly
3. Heated to 60° C (140° F)
4. Thickened with sawdust
5. Mixed with Epsom salts

1. The best adhesive to repair a break to your guitar is…
2. PVA (wood) glue
3. CA (super) glue
4. Epoxy
5. Depends on the circumstances

Key

1 – A

2 – D

3 – C

4 – D

5 – D

6 – D

7 – A

8 – B

9 – B

10 – D

* Include at least 10 quiz questions with answer key. (Questions must be Multiple Choice, and/or Matching).

**For Further Study – Independent research**

**Define:** Catalyst, Cohesion, Adhesion, Amorphous phase, Aerobic, Anaerobic, Collagen, Elastomer, Inhibitor, Plasticity, Polymerization, Resin, Substrate, and Thixotropic

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