

Pool Size and Flame Height Comparison on Different Surfaces

Nicholas Markham, Dr. Nicole Eyet and Dr. William Ryerson

Background

- Research has been done on burning rate on porous media (such as carpet), where researchers developed and tested a heat and mass transfer theory, which was validated by their experiment and results.
- Researchers have been focused on room fires and the spread of flames involving carpet systems. Previous work by others has designed experiments where a chair or other items of furniture became the first item to burn. Additionally, several small-scale carpet test gathered information on temperature distribution and incident heat flux relating to the floor material.

Introduction

- This research focuses on flame height relative to the amount of lighter fluid and the type of surface being burned. As well as, trying to determine if certain types of burning carpet influences the flame height.
- This research also looked at determining the surface area of various pool sizes in an attempt to characterize pour patterns by volume.

Picture 1: 2mL of lighter fluid on light carpet, producing a flame height of 32.464 cm.



Methods

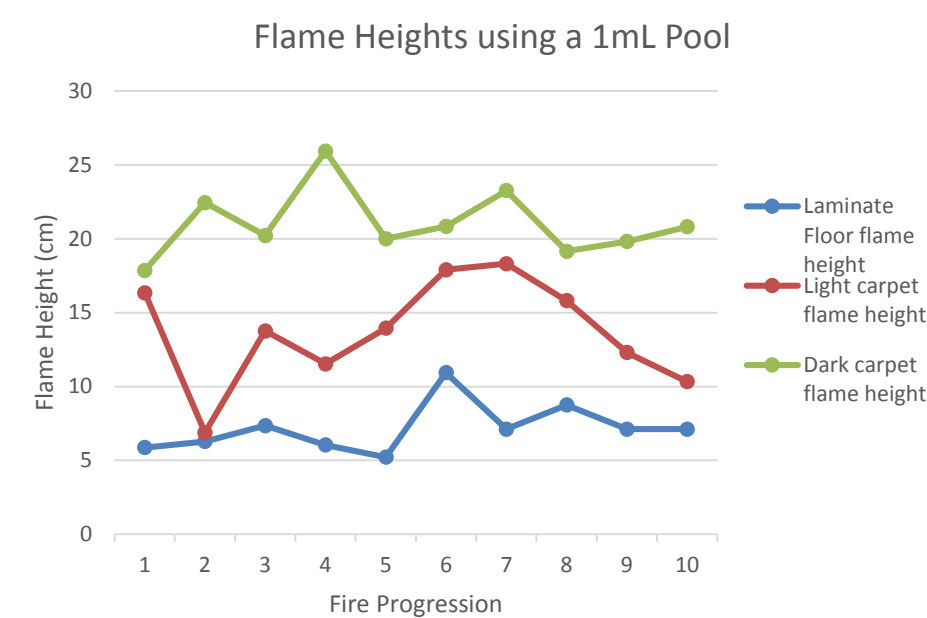
Pool Size

- Measure out 1mL of solution (45% acetone/ 45% cyclohexane/ 10% food coloring) and pour onto one surface.
- Immediately take photo of pour, with meter stick in frame.
- Repeat 5 times for each surface with 1mL and then repeat with 2mL and 4mL.
- Use Image J to analysis pool sizes and determine area and perimeter. Use meter stick as a scale.

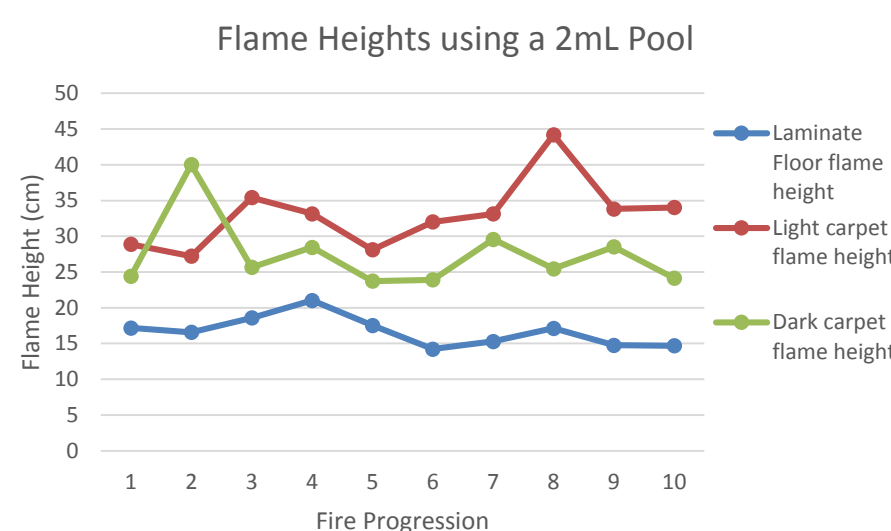
Flame Height

- Set up table, with a backdrop and a meter stick in the vertical position.
- Place experimental surface (e.g. Laminate/ Carpet, etc.) on table.
- Measure out 1 mL of lighter fluid and pour on surface.
- Have a camera positioned in front of table to record burning.
- Light lighter fluid on fire and record burn. Repeat multiple times for each surface and repeat with 2mL and 4mL.
- Use imageJ to analysis peak flame height and use meter stick as reference height and scale.

Flame Height



Graph 1: The flame heights on three different surfaces. The laminate floor produces the smallest flame height. Both carpets yield larger height, when equal volume was added.



Graph 2: Flame heights on laminate flooring, dark and light carpet. The flame height is greater on the two types of carpet, than the laminate floor.

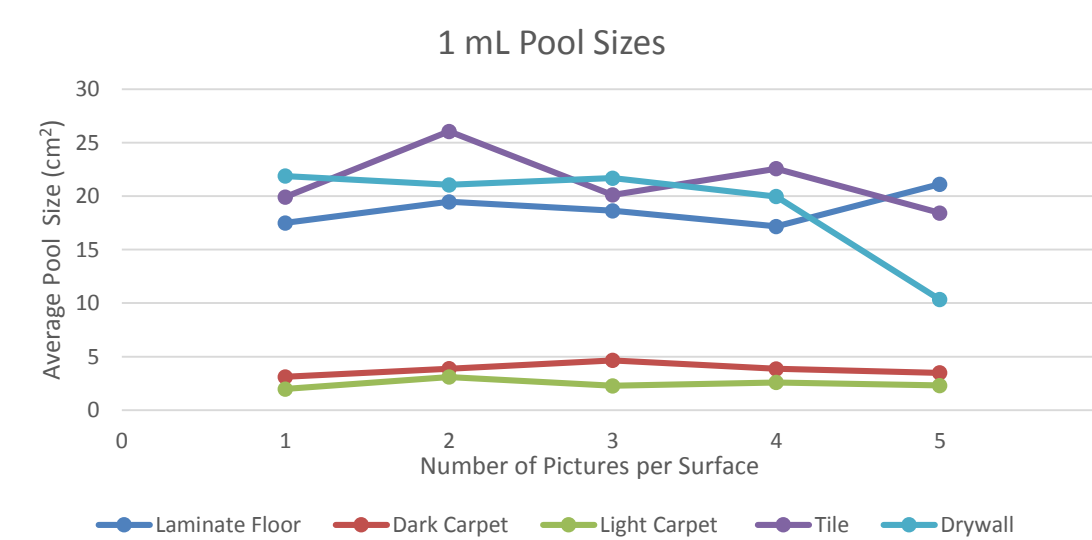


Picture 2: 4mL pool size on Drywall, with an average area of 100.5858 cm².

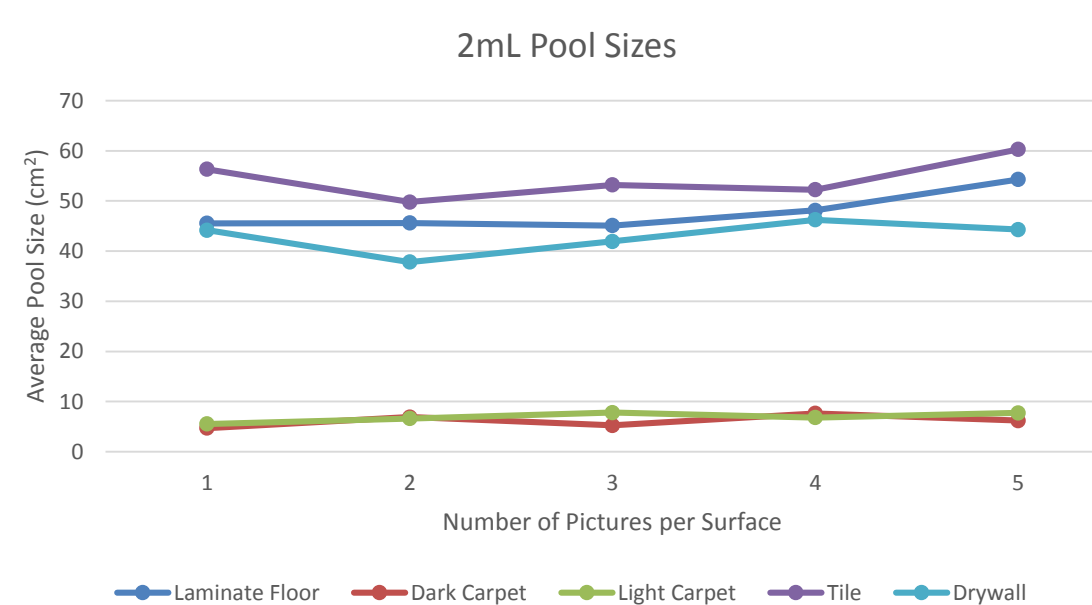


Picture 3: 1 mL of lighter fluid on Dark Carpet, producing a flame height of 23.265 cm

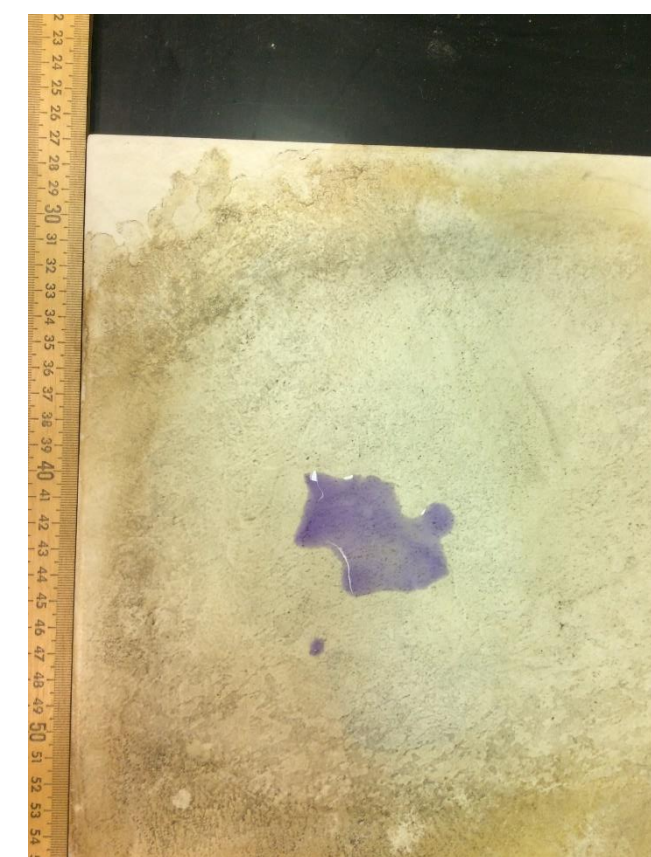
Pool Size



Graph 3: Two types of carpet have similar pool sizes; the other three surfaces are similar. Across surfaces, they are not consistent. The same amount of liquid does not produce repeatable areas.



Graph 4: Average pool sizes relative to other surfaces using 2mL of liquid. Pool sizes vary in area, when compared across surfaces and also when compared to another pour of the same amount of liquid.



Picture 4: 1mL pool size on tile, with an average area of 20.1152cm².

Discussion and Conclusion

Table 1: Average Flame Height (cm) on various surfaces by pool sizes		
Surface	1mL	2mL
Laminate Floor	7.1818	16.7038
Light Carpet	13.7127	33.0024
Dark Carpet	21.0345	27.3968

Table 1: Shows the average flame heights on various surfaces. All three flame heights got larger with more lighter fluid, but the light carpet yield the biggest difference from 1mL pool sizes to 2mL pool sizes.

- Flame height is greater on carpeted surfaces.
- Laminate floor yielded the smallest flame height, while the light carpet had an average flame height greater than laminate flooring. Dark Carpet had the highest average flame height, with 1mL of lighter fluid used.
- When 2mL of lighter fluid was added to the three different surfaces, the laminate floor produced the smallest flame height again and the light carpet produced a largest flame height.
- This data indicates that the carpets surfaces influence the flame heights of equal addition of lighter fluid

Table 2: Average Pool Size area (cm) on Various Surfaces					
Surfaces	Drywall	Laminate Floor	Tile	Dark Carpet	Light Carpet
Total average of 1mL	21.88	18.78	21.41	3.79	2.44
Total average of 2mL	42.90	47.75	54.40	6.15	6.91
Total average of 4mL	92.87	116.76	115.27	11.33	11.68

Table 2: The average pool sizes on various surfaces is not very consistent. Same volume pours on each surface do not produce similar area's, therefore there is no indication of being able to produce repeatable pool sizes.

- As indicated in the table above, the average pool size areas are different, when comparing the hard surfaces(Drywall, Laminate Floor and Tile) to the soft surfaces (Carpets). This could be due to the soft surfaces absorbing the liquid, where the hard surfaces allow the liquid to spread.
- The consistency of pool sizes on the same surface proved to be successful most of the time. Error took place when analyzing the pool sizes and also with the consistency of the pours.

References

- Ma, T., Olenick, S. M., Klassen, M. S., Roby, R. J., & Torero, J. L. (n.d.). Burning Rate of Liquid Fuel on Carpet (Porous Media). Retrieved April 25, 2017, from <https://link.springer.com/article/10.1023/B:FIRE.0000026878.29456.3c>
- Flame Spread of Carpet Systems Involved in Room Fires. (n.d.). Retrieved April 25, 2017, from <http://fire.nist.gov/bfrlpubs/fire76/art001.html>