

WHEN BUILDINGS FIGHT BACK!



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Purpose

The purpose of this experiment is to find out how different building structures and natural flame retardants affect how quickly a building burns. This project compares buildings with reinforced walls and regular walls, and tests whether using borax, baking soda, or no flame retardant changes how fast the buildings burn. The goal is to determine if the type of structure, the use of natural flame retardants, or a combination of both can help a building burn more slowly.

Hypothesis

My hypothesis is that the reinforced structure and borax solution will be the best combination of structure and flame retardant to make the buildings burn the slowest.



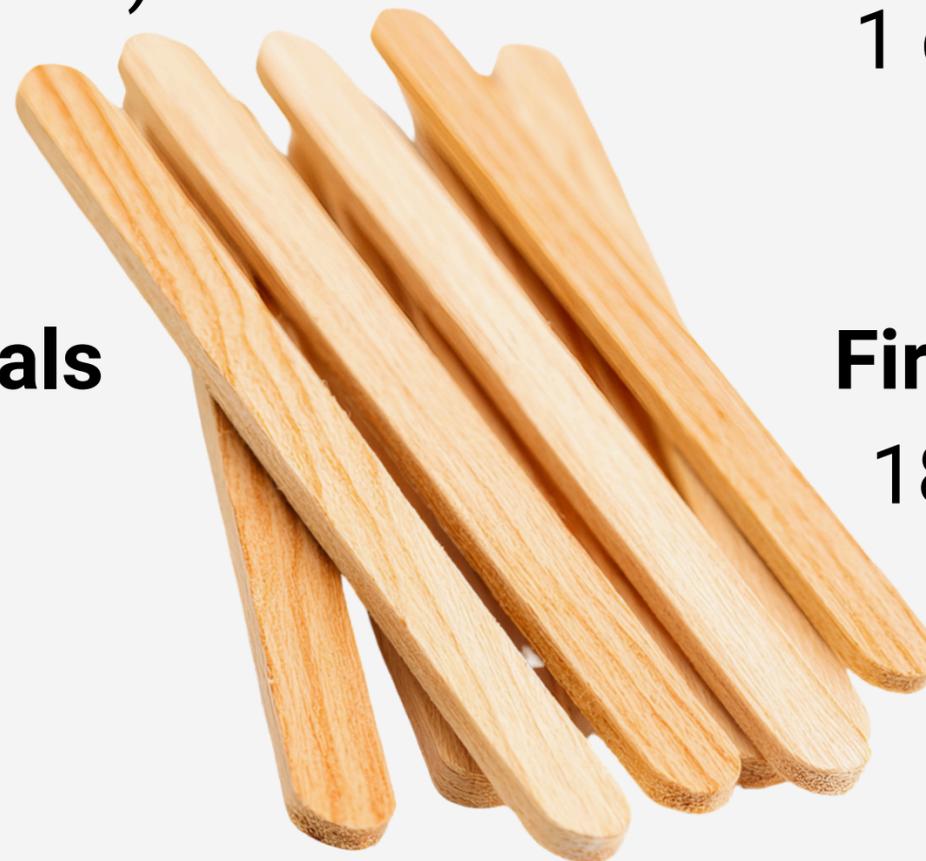
Materials

House Building Materials

864 wooden dowel rods (6 in × ½ in)
180 large craft (popsicle) sticks
18 plywood roof pieces (10 in × 10 in)
Wood glue
Wall-building template
Putty knife

Safety & Data Collection Materials

Shovel
Notebook



Flame Retardant Materials

2 tablespoons borax
2 tablespoons baking soda
1 cup measuring cup
2 spray bottles

Fire Testing Materials

18 fire starter sticks
18 paper towels
Fire torch
Stopwatch

Procedure

Building the Regular Houses

1. Use the wall-building template to construct the walls.
2. For three walls, place 12 dowel rods into the template and glue them together using wood glue.
3. Allow the walls to dry completely, then carefully remove them from the template using a putty knife.
4. For the fourth wall (the door wall), place four 6-inch dowel rods, four 3-inch dowel rods, and four more 6-inch dowel rods into the template to create a doorway. Glue the rods together and allow the wall to dry. Remove it carefully with a putty knife.
5. Once all four walls are dry, glue them together to form an open topped house.

Building the Reinforced Houses

1. Use the wall-building template to construct the walls in the same way as the regular houses.
2. Create three walls using 12 dowel rods each and one wall with a doorway using four 6-inch rods, four 3-inch rods, and four more 6-inch rods.
3. After each wall dries and is removed from the template, reinforce it by gluing large popsicle sticks to the wall:
 - Two popsicle sticks at the top
 - One popsicle stick in the middle
 - Two popsicle sticks at the bottom
4. Trim the popsicle sticks so the doorway remains open.
5. Once all reinforced walls are dry, glue them together to form an open topped house.

Procedure Cont.

Applying Flame Retardants

1. Label three houses "Borax."
2. Mix one cup of warm water with two tablespoons of borax and pour the mixture into a spray bottle.
3. Spray the borax solution evenly onto the labeled houses and allow them to dry completely.
4. Label three houses "Baking Soda."
5. Mix one cup of warm water with two tablespoons of baking soda and pour the mixture into a spray bottle.
6. Spray the baking soda solution evenly onto the labeled houses and allow them to dry completely.
7. Label three houses "No Flame Retardant."
8. Do not apply any solution to these houses.

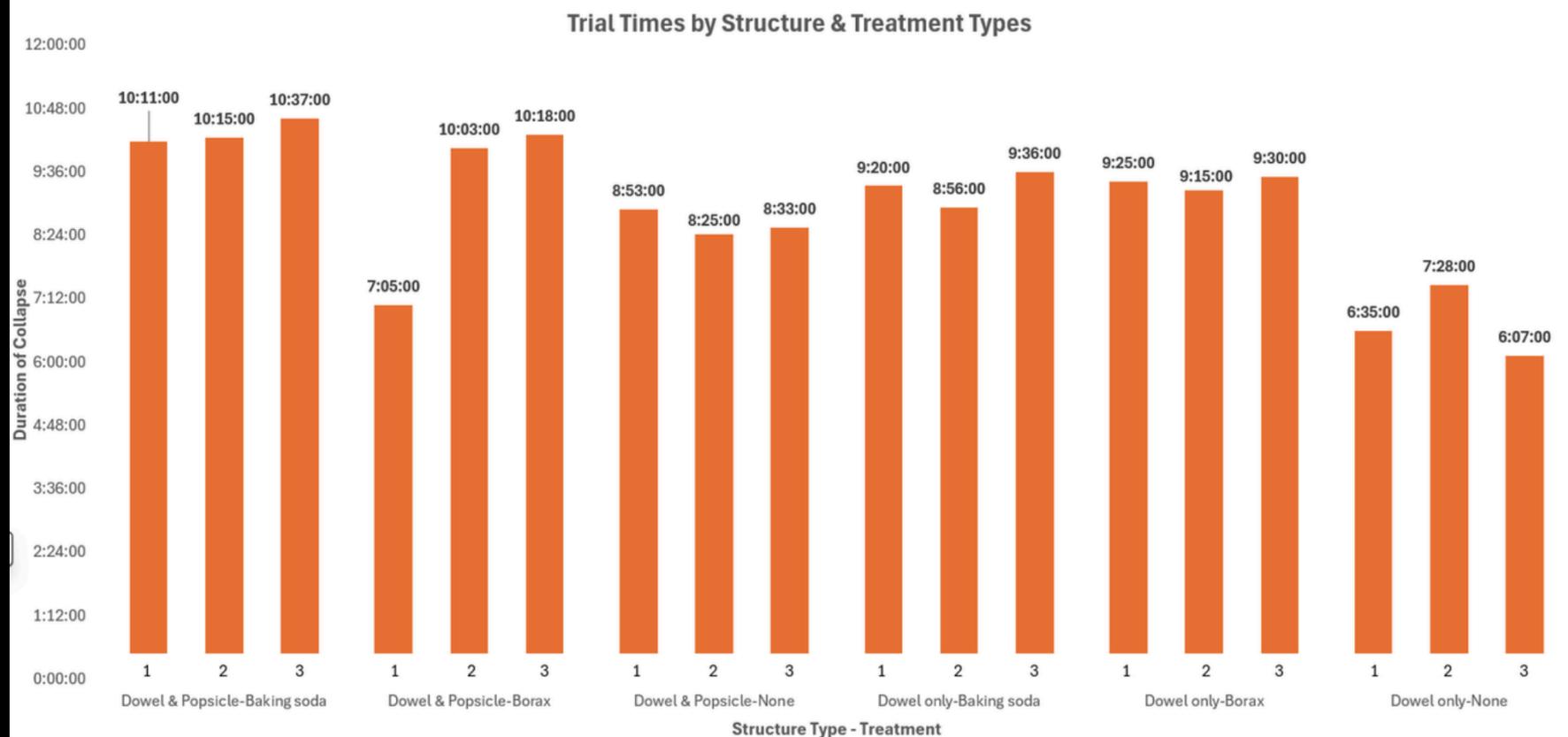
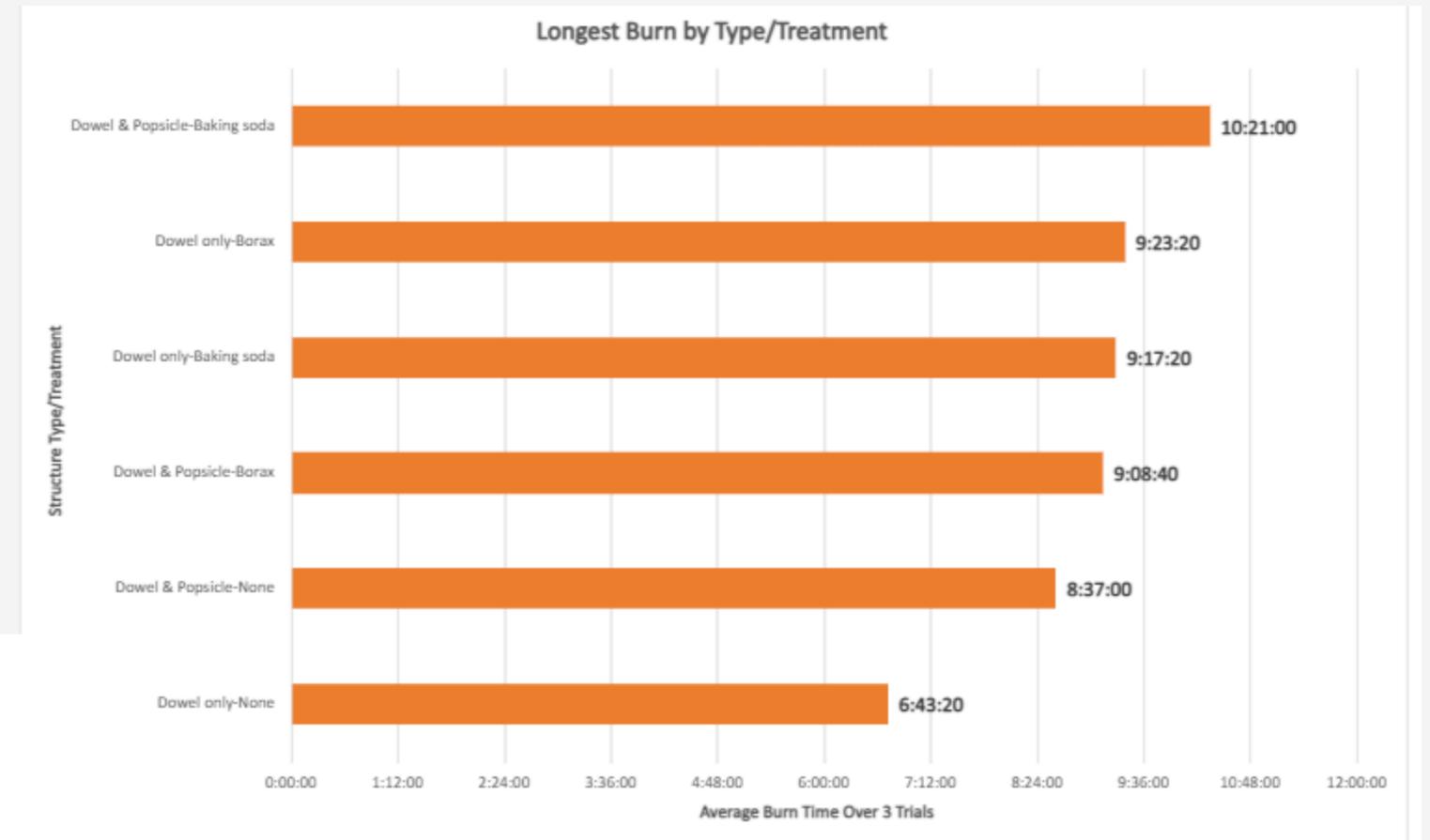
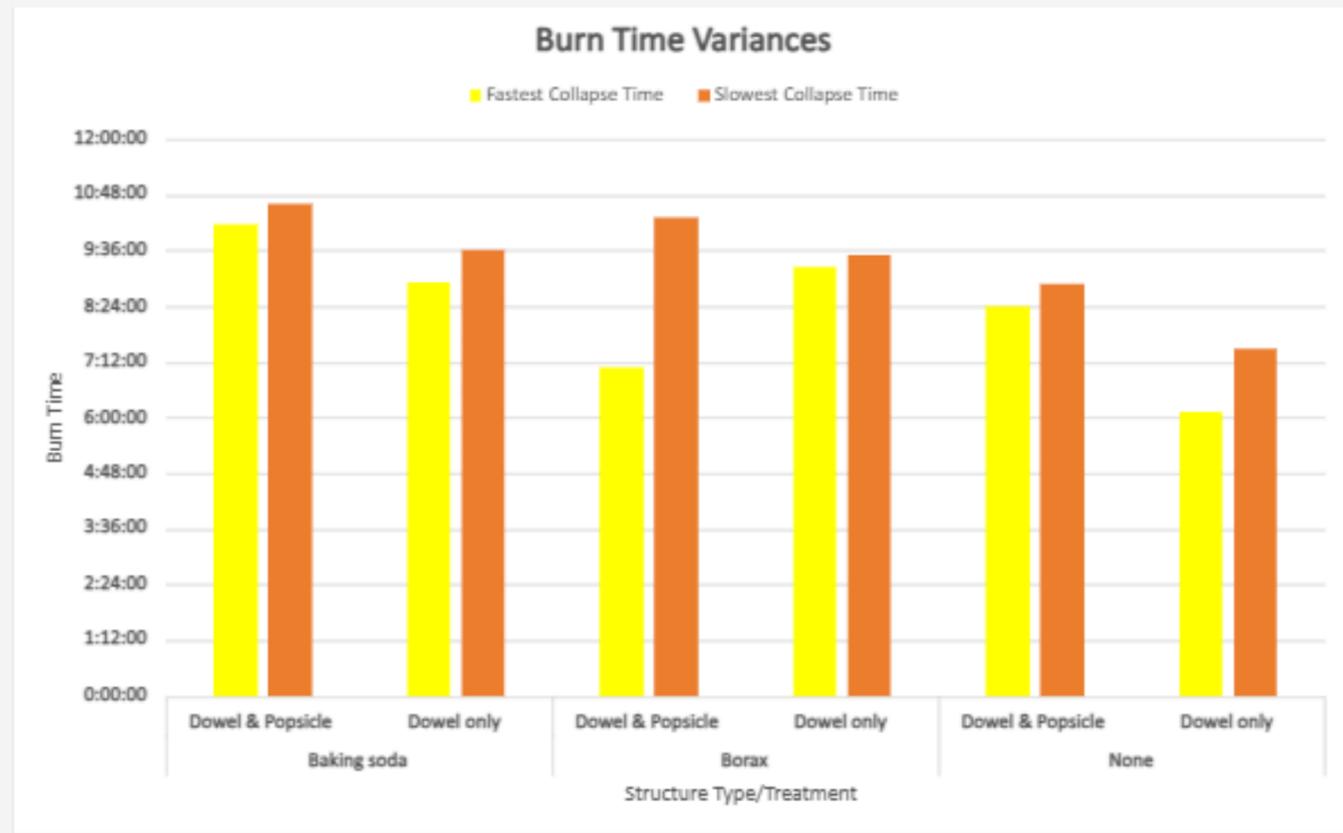
Fire Testing

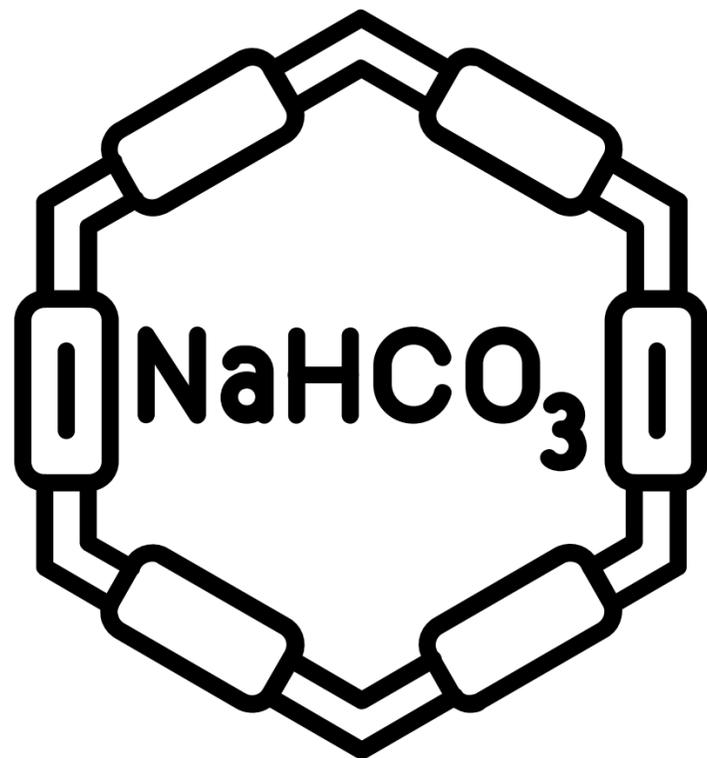
1. Place one house on a cleared area of the driveway.
2. Insert one fire starter stick diagonally inside the house so it touches the back right corner.
3. Add one paper towel next to the fire starter stick.
4. Place the plywood roof on top of the house.
5. Get the stopwatch ready.
6. Use a fire torch to light the paper towel for 2 seconds.
7. Start the stopwatch as soon as the paper towel ignites.
8. Stop the stopwatch when the roof begins to fall.
9. Record the time in a notebook.
10. Put out the fire using a shovel full of snow and clear the area.
11. Repeat the test three times for each flame retardant type: borax, baking soda, and no flame retardant.

Data & Results

Trial #	Structure type	Treatment	Ignition Time	Collapse Time	Notes
1	Dowel & Popsicle	Baking soda	0:00:00	10:11:00	It burned a lot of the top of the roof but the flames stayed in the middle making the walls slower to
2	Dowel & Popsicle	Baking soda	0:00:00	10:15:00	The flames became really big in the end.
3	Dowel & Popsicle	Baking soda	0:00:00	10:37:00	
1	Dowel & Popsicle	Borax	0:00:00	7:05:00	The char from the fire seemed to burn both on the outside as well as the inside.
2	Dowel & Popsicle	Borax	0:00:00	10:03:00	
3	Dowel & Popsicle	Borax	0:00:00	10:18:00	
1	Dowel & Popsicle	None	0:00:00	8:53:00	The popsicle sticks made it burn slower compared to the dowel only houses.
2	Dowel & Popsicle	None	0:00:00	8:25:00	
3	Dowel & Popsicle	None	0:00:00	8:33:00	
1	Dowel only	Baking soda	0:00:00	9:20:00	Flames started to ignite quicker but took longer to collapse the house.
2	Dowel only	Baking soda	0:00:00	8:56:00	The flames were very little and didn't consume the house that much.
3	Dowel only	Baking soda	0:00:00	9:36:00	
1	Dowel only	Borax	0:00:00	9:25:00	Burnt through the inside at a medium speed.
2	Dowel only	Borax	0:00:00	9:15:00	At first the flames didn't catch that well and were weak.
3	Dowel only	Borax	0:00:00	9:30:00	
1	Dowel only	None	0:00:00	6:35:00	The flames immediately went up the walls and out the roof.
2	Dowel only	None	0:00:00	7:28:00	The flames grew really quickly, causing it to burn fast.
3	Dowel only	None	0:00:00	6:07:00	

Data & Results Cont.





Analysis

Treatment Analysis: Baking Soda was the best overall, borax was a close second, no treatment was the worst.

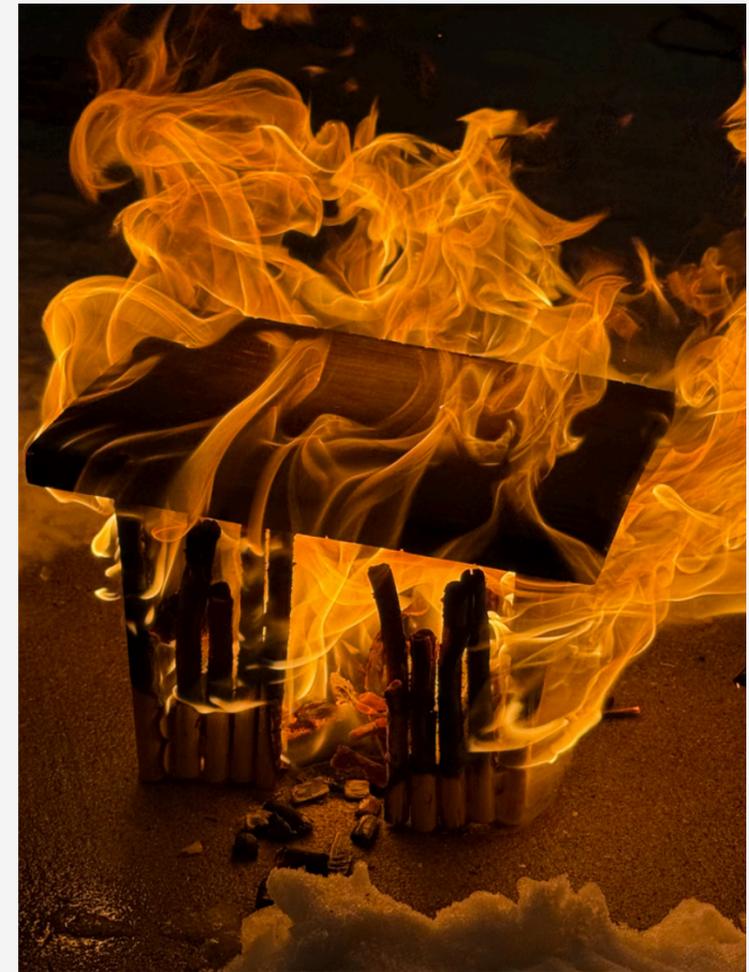
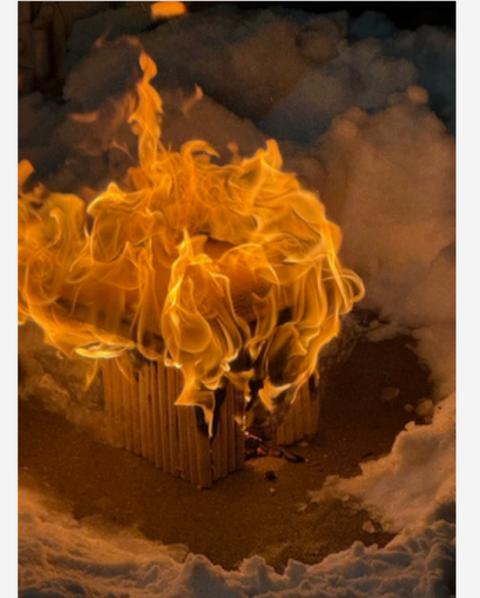
Effect of Structure: Dowel & Popsicle structures lasted longer in most cases and extra reinforcement mattered.

Consistency: Baking soda trials were very consistent, the borax had more variation (especially first trial: 7:05 I think there was an outside variable like the wind picking up causing a faster burn). I have learned in the future this should be thrown out.

Conclusion

The baking soda treated houses with reinforced walls burned the slowest. This shows that both baking soda and the reinforced wall design improved fire resistance. Because the borax-treated reinforced houses did not burn the slowest, my hypothesis was partially wrong. The best combination was baking soda with reinforced walls, not borax with reinforced walls.

Highlights



Resources

Articles about baking soda as a fire retardant:

<https://firefighternow.com/is-baking-soda-flammable/>

<https://preparedhero.com/blogs/articles/can-you-use-baking-soda-to-put-out-a-kitchen-fire>

https://www.greenlivingtips.com/articles/baking-soda-introduction.html#google_vignette

Articles about borax as a fire retardant:

<https://www.sciencelearn.org.nz/resources/765-chemical-fire-retardants>

<https://www.borax.com/news-events/january-2026/wood-products-flame-retardancy>

<https://www.youtube.com/watch?v=F0DETRrZPao>

Chemical fire retardants in general:

<https://www.sciencelearn.org.nz/resources/765-chemical-fire-retardants>

How fires spread:

<http://target-fire.co.uk/resource-centre/how-do-fires-spread/>

Creating better structure for fire prevention:

<https://www.youtube.com/watch?v=9NFoMPJGmao>

<https://www.youtube.com/watch?v=IEOmSN2LRq0>

<https://www.familyhandyman.com/article/fire-blocking-basics-what-every-homeowner-needs-to-know/>

[srsItd=AfmBOoptZIKUkV080BnpdJ2Vp8bIshCrv6xRjeidBlf3cchXgGaUDoi1](https://www.youtube.com/watch?v=9NFoMPJGmao&list=PLAfmBOoptZIKUkV080BnpdJ2Vp8bIshCrv6xRjeidBlf3cchXgGaUDoi1)

