

Burning Performance of White Oak, Cedar, and Pine

Category

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ABSTRACT

The primary uses for a campfire are light, heat, and cooking. I have studied the burning characteristics of three common types of wood: white oak, cedar, and pine to see which wood is best suited for each use of a campfire.

I hypothesized that white oak would burn the longest, pine would have the highest flame and that resins would make the flame go higher.

To conduct my experiment and test my hypothesis, I built three fires using each of my pre-selected types of wood. I took 5 equal-size pieces of each type of wood and built fires using them. I measured the time that the fire took to burn. I also measured the flame height throughout the burning process. I compared the differences in time and flame height and came to a conclusion.

I found that white oak burned the longest (10 min. 45 sec.) and had the highest flame (62 cm). Cedar burned for the shortest amount of time (8 min. 54 sec.), but had the second highest flame (40 cm). Pine burned the second longest (9 min. 3 sec.) but had the shortest flame (30 cm).

I concluded that:

- Hardwoods burn longer than softwoods.
- Resins make the wood burn longer.
- Strong winds supply more oxygen, allowing the fire to burn faster.
- Resins produce smoke and soot.
- Resins do not help the flame height.

TABLE OF CONTENTS

INVESTIGATIVE QUESTION, PURPOSE, AND HYPOTHESIS	4
INTRODUCTION.....	5
MATERIALS AND METHOD	6
RESULTS	7
CONCLUSIONS	9
ACKNOWLEDGEMENTS	11
BIBLIOGRAPHY	12

INVESTIGATIVE QUESTION, PURPOSE, AND HYPOTHESIS

Investigative Question:

Which wood burns the longest with the highest flame?

Purpose:

I would have the information needed to know what wood burns the longest and which one has a higher flame.

Hypothesis:

1. White oak would burn the longest because I thought that the denseness of the wood would burn longer.
2. Pine would have the highest flame because it had more resins.
3. Resins would make the flame go higher because it seemed like it would be fuel because pine sap is useful as a fire starter.

INTRODUCTION

I studied the burning characteristics of some common wood fuels because I wanted to know what type of wood to burn in the various situations where I would need it. I need to know how long wood burns, how completely it burns, and how high a flame it produces. In Boy Scouts, knowing how a type of wood burns could help me.

For a signal fire, I would want a wood that had a high flame and lasted longer so I would not have to rebuild it as often.

For a ceremonial bonfire, I would like a wood that burned with a high flame and burned the wood all the way down so that I would not have to clean it up.

For light, I would want a wood that produced a high flame to illuminate the area around me.

For cooking, I would want wood that has long-lasting coals and a minimum of smoke or soot.

Knowing which wood is best for each type of fire will help me to always “Be Prepared!”

MATERIALS AND METHODS

Procedure:

1. Gather wood; White Oak, Cedar, and #2 Pine
2. Cut all wood to 15 cm. Length, 1.5 cm. Depth, 1.5 cm. Width. Make five strips of each like this.
3. Put five strips in a teepee shape in the fire pit.
4. Put Cedar shavings in the fire pit around the edges and in the middle.
5. Put Cedar shingles around wood and shavings.
6. Light fire with match and put lit match in tinder. Try again if it doesn't light.
7. Time from when fuel ignites in visible flame (start when you see it catch on fire).
8. Stop time when last visible flame goes out.
9. Record and repeat.

Materials:

1. Coleman Fire Pit – 18in. x 24in. (with sand at bottom)
2. White Oak firewood, seasoned
3. Cedar firewood, seasoned, weathered
4. Pine firewood #2
5. Kindling/Cedar shingles
6. Tinder/Cedar chips
7. Diamond Strike Anywhere matches
8. Stop watch
9. Digital camera

Independent Variables:

The pieces of wood I chose to burn.

Responding Variables:

The time it takes for the fire to burn out.

The height of the flame.

Controlled Variables:

Same place, same tinder, same kindling, same matches, same amount and size of wood.

RESULTS

I have burned three different types of wood. I have burned Cedar, White Oak, and Number two Pine. I burned them all on different days and at different times of day.

White Oak took the longest to burn all the way down. White oak also had the highest flame. It was 22 centimeters higher than Cedar and 32 centimeters higher than Pine. It took 10 minutes and 45 seconds to burn. The highest flame was at 6 minutes and 15 seconds and was 62 centimeters high. The average flame height was 28 centimeters high. When this part of the experiment was tested there were large wind gusts. All of the wood burned except for the bottom of one strip. The relative humidity at the time of the testing was 34% and the temperature was 62 degrees Fahrenheit or 58 degrees Celsius. The fire burned hotter than any other wood that I tested.

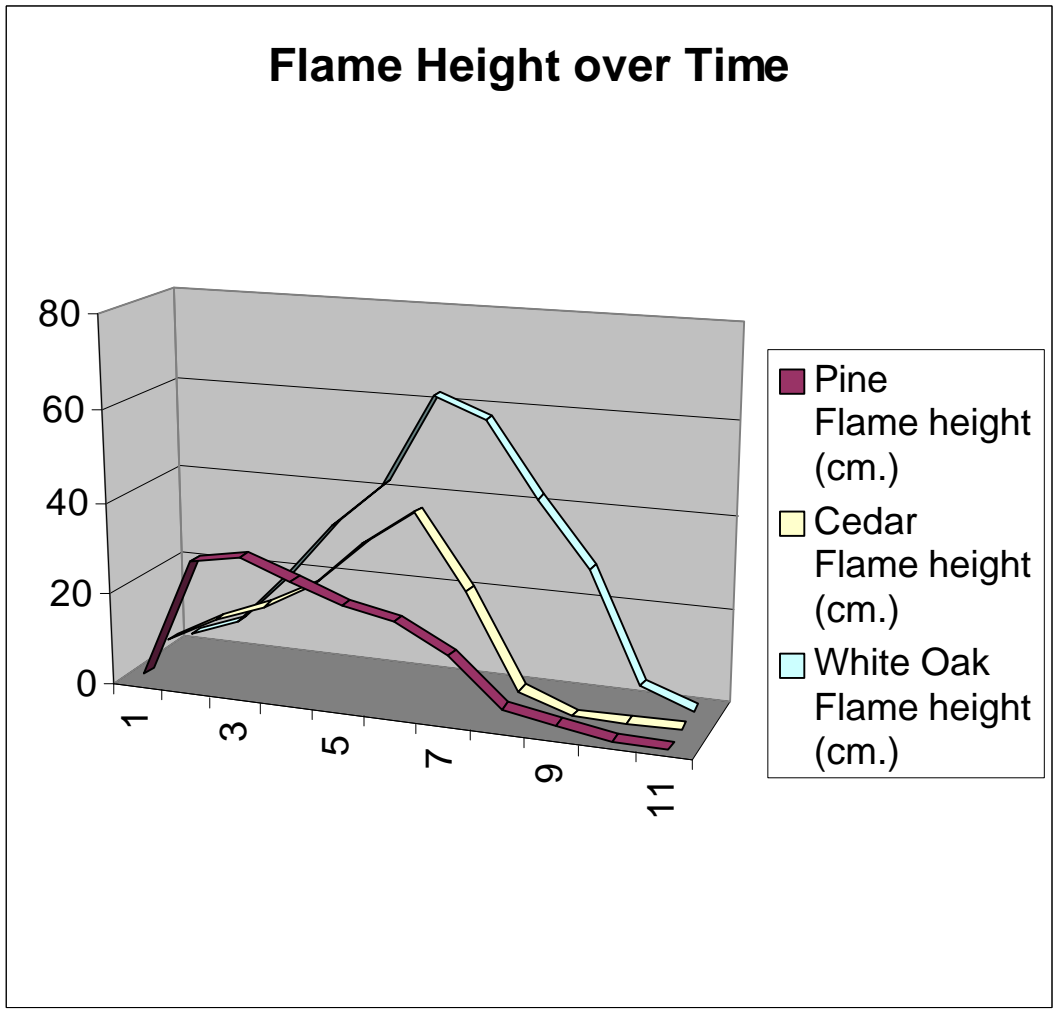
Cedar took the shortest time to burn and had the second highest flame. It was 10 centimeters higher than Pine. It took 8 minutes and 54 seconds to burn itself out. The highest flame was 40 centimeters on the 6th minute of the testing session. The average flame height was 19 centimeters. It took me 3 tries to start the fire. Most of the wood burned, but the bottom half did not burn much. The relative humidity was 34% and the temperature was 58 degrees Fahrenheit or 14 degrees Celsius.

Pine took the second longest to burn and had the lowest flame. It took 9 minutes and 3 seconds to burn all the way down. The highest flame height was 30 centimeters. The average flame height was 16 centimeters. The time at the highest flame was 3 minutes into the testing session. The fire was particularly Smokey once it got started. The strips were almost completely burned but the backsides were not burned as much. The relative humidity was 33% and the temperature was 42 degrees Fahrenheit or 6 degrees Celsius.

The results are shown on the tables and charts below.

Wood Type	Flame Ht(cm)	Time (m:s)	Air Temp. (deg F)	Comments
#2Pine	30	9:03	42	Rel. Humidity 34%, Smokey, Most of wood burned.
White Oak	62	10:45	62	Rel. Humidity 33%, Very Windy, All wood burned.
Cedar	40	8:54	58	Rel. Humidity 34%, 3 tries to start, Most of wood burned.

Time (min.)	Pine Flame height (cm.)	Cedar Flame height (cm.)	White Oak Flame height (cm.)
1	2	6	4
2	28	12	8
3	30	16	19
4	26	22	32
5	22	32	42
6	20	40	62
7	14	24	58
8	4	4	42
9	2	0	28
10	0	0	4
11	0	0	0



CONCLUSIONS

I tested 3 types of wood: cedar, white oak and pine. White Oak burned the longest with the highest flame. Cedar burned the shortest with the second highest flame. Pine burned the second longest and had the smallest flame. I conclude that:

1. Hardwoods burn longer than softwoods. White oak burned the longest because it is a hardwood. Being a hardwood means it's denser and harder. Being dense helps it to burn longer because the wood is compacted allowing more fuel in the same size sticks. The denseness helps produce heat making the flame rise. Cedar burned for the shortest amount of time because it was a less dense softwood and it had very little resins to burn.
2. Resins make the wood burn longer but do not produce a flame. White oak's flame was the highest because it had no resins in it. Having no resins in the wood allows the flame to reach its maximum height. Of the softwoods, pine burned longer than cedar because the resins prolonged the fire. Pine had the lowest flame because there were a lot of resins in its wood and they do not help the height of the flame. Because the resins burned longer in the pine but didn't add much heat to the fire, not all of the wood burned, but most of it did.
3. Strong wind supplies more oxygen, allowing the wood to burn faster. The wind affected the flame height and the amount of time white oak burned. White oak could have burned longer but as it died down the wind blew the flame out. The wind also helped the wood burn all the way down.
4. Resins produce smoke and soot. Pine was so smoky because when the resins burned they produced soot. As they burned they created a lot of soot because the resins let off carbon dioxide as they burned.
5. Resins do not help the flame height. Cedar's flame was second highest because it had less resins than pine. Even though it is a softwood, it could not burn as hot and was unable to produce a very high flame compared to white oak. Cedar took 3 times to start because it had no resins to burn and was a softwood of little density.

Hypothesis

My hypothesis was that

1. White oak would burn the longest because I thought that the denseness of the wood would burn longer.
2. Pine would have the highest flame because it had more resins.
3. Resins would make the flame go higher because it seemed like it would be fuel because pine sap is useful as a fire starter.

I was correct on one of my hypotheses. White oak did burn the longest but pine did not have the highest flame. White oak had the highest flame. The fact that resins hurt the height of the flame was unexpected.

If I were to do this experiment over I would do more tests of each type of wood to make sure of my results.

ACKNOWLEDGEMENTS

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