

Charcoal Burn Test
Comparative Analysis

Prepared for:

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INTRODUCTION

At the request of Coshell Holdings LLC., Stephanos & Associates conducted a testing program of comparative performance of three separate charcoal briquette manufacturers. Nine replicate test runs were completed, three for each manufacturer. The highest performing test for each manufacturer sample is provided within this report.

Stephanos & Associates is an independent company not affiliated with any charcoal manufacturer.

SUMMARY OF RESULTS

This summary attempts to disseminate the basic points illustrated in the following test data. Please review the information within this report for a more detailed analysis.

1. Total time to achieve complete ash over of briquettes:

BEST PERFORMERS

- Sample "A" 35 minutes
- Sample "B" 35 minutes
- Sample "C" 1 hour 15 minutes

SAMPLES "A" & "B"

2. Total burn time:

- Sample "A" 3 hours 30 minutes
- Sample "B" 3 hours
- Sample "C" 3 hours 30 minutes

SAMPLES "A" & "C"

3. Maximum grill probe temperature:

- Sample "A" 560 degrees F
- Sample "B" 471 degrees F
- Sample "C" 391 degrees F

SAMPLE "A"

4. Maximum Surface temperature achieved:

SAMPLES "A" & "B"

- Sample "A" 988 degrees F
- Sample "B" 988 degrees F
- Sample "C" 925 degrees F

5. Sustained time above 180 degrees F "optimum cooking range:"

SAMPLE "A"

- Sample "A" 2 hours 10 minutes
- Sample "B" 1 hour 20 minutes
- Sample "C" 2 hours

6. Observations:

- Sample "A" - Mild odor
 - Fast start
 - Once full ash was achieved, ash sluffed off exposing inner core of hot briquette.
 - This allowed for continuous heat exposure.

- Sample “B” - Fast start
 - Acrid, unpleasant odor
 - Majority of ash was maintained as a whole on briquette, encapsulating inner core.
 - Briquettes are small creating excessive surface area. This promoted rapid burn and decreased overall burn time.

- Sample “C” - Acrid and very unpleasant odor
 - Slow start
 - Briquettes released sparks and embers during ignition and up to full ash over. This characteristic may be viewed as unsafe in open exposed grilling areas and wild land space.
 - Ash over was consistently slow.
 - Majority of ash was maintained as a whole on briquette, encapsulating inner core.

CONCLUSION:

Both samples “A” and “B” ignited quickly and achieved adequate grill temperatures rapidly. Samples “A” and “C” exhibited extended burn times. The data indicates that sample “A” outperformed all samples repeatedly in every data point. Additionally, the low odor emission from sample “A” created a more friendly grilling environment.

TEST EQUIPMENT

1. Reference Barbecue Grill

The charcoal was ignited in a Weber “Go Anywhere” Barbecue grill (model Number #121001), 15.5” X 9.5”X5.0”, with the grate 1.75” above the bottom of the grill. The grill was set on it’s support feet, and then placed in the test area. The grill air vents were in full closed position.

2. Analytical Balance

An electronic scale with a resolution of +/- 0.1 grams was used to weigh the charcoal for testing.

3. Charcoal Stacking Ring

A rigid plastic cylinder 8.5” inches in diameter with indicators to determine that the pile of briquettes does not exceed 5” inches in height was used to position the briquettes within the test grill.

4. Grill Temperature Monitoring

An EXTECH Easy View 11A Type K was coupled with the grilling probe. Max temperature readings were conducted every 5 minutes with a 10 second sampling time window.

5. Grill Temperature Probe

A type “K” thermocouple was mounted to a CEN-Tech magnetic base with adjustable articulating rails. The probe was placed in the stand to maintain 2” inches above the maximum height of the briquette pile. It was made as such so that it can be removed and replaced within the test area.

6. Surface Temperature Monitoring

A CEN-Tech Non-Contact Laser Thermometer was used to measure surface temperature. The readings were taken at a measurement of 15’ inches from the top of the briquettes. To maintain repeatability the laser was focused at a predetermined location upon the briquette surface.

7. Camera

To document the ignition and burn conditions of the charcoal, a Canon PowerShot SX210 IS camera was used. Photos were taken every 5 minutes indicated by the timing clock.

8. Test Structure

A 10’ X 12’ X 8’ four sided rigid wind barrier was erected to encompass the localized outdoor test burn area.

9. Ignition Fluid

A combustible mixture consisting of petroleum distillates or commonly known as charcoal starter fluid was acquired at a local retailer. The starter fluid complies with South Coast Air Quality Management District Rule 1174. The recommended volume of starter fluid as stated on the directions label is 50 milliliters per pound of charcoal briquettes. A 150 ml. Pyrex graduated cylinder was used to measure ignition fluid.

10. Charcoal Briquettes

Three sample charcoal briquette products were supplied by Coshell Holding LLC. The sample bags were new and unopened.

11. Charcoal Storage & Handling

The charcoal samples were stored in a controlled environment consisting of a relative humidity of 30 to 50% and 60 to 75 degrees F.

12. Ignition Device

A Bernz-O-Matic TS2000 propane torch with a piezoelectric igniter was used to ignite the starter fluid.

Test Procedures

1. Barbecue Placement

The barbecue was placed in the center of the test structure with the support feet firmly locked into possession.

2. Charcoal Measurement & Placement

A containment vessel was placed on the analytical balance and a tare weight was taken. Once the balance was zeroed, 2 lb. of charcoal was placed into the container from a newly opened bag. Only whole briquettes were used.

The charcoal-stacking ring was placed in the center of the grill and the 2 lb. of briquettes were then gravity fed into the stacking ring. A random placement of the briquette was allowed to occur. This method was used to eliminate any manipulation of the briquettes for a biased result. The stacking ring was removed and the briquettes settled into final position for testing.

3. Ignition Fluid & Ignition

Following the lighter fluid manufacturers guidelines of 50 ml. per 1 lb. of charcoal, 100 ml. of lighter fluid was measured out in a graduated cylinder to accommodate the 2 lb. burn test. The lighter fluid was evenly distributed manually onto the briquettes until all the fluid was fully dispensed.

Immediately after the lighter fluid was applied (as directed by the instructions on the lighter fluid packaging), the charcoal briquette pile was ignited using the ignition source. This is described as “flame on.” Once all the lighter fluid has burned off, this is indicated as “flame off.”

4. Photographic Documentation

Once briquettes were placed into the grill, the photo documentation was initiated. Images were taken at five-minute intervals for the duration of each test.

5. Temperature Data Monitoring

The grill temperature probe was placed 2 inches above the charcoal briquette pile after the initial burn off or “flame off” of the lighter fluid was complete. Max temperature readings began with both grill probe and infrared surface reading, at the 10 minute interval mark for each test. Then data sampling was conducted every 5 minutes with a 10 second sampling time window for each 5 minute interval.

6. Test Termination

Tests were considered complete when the grill probe temperature was within 25 degrees of the ambient temperature or when test burn timed out at 3.5 hours.

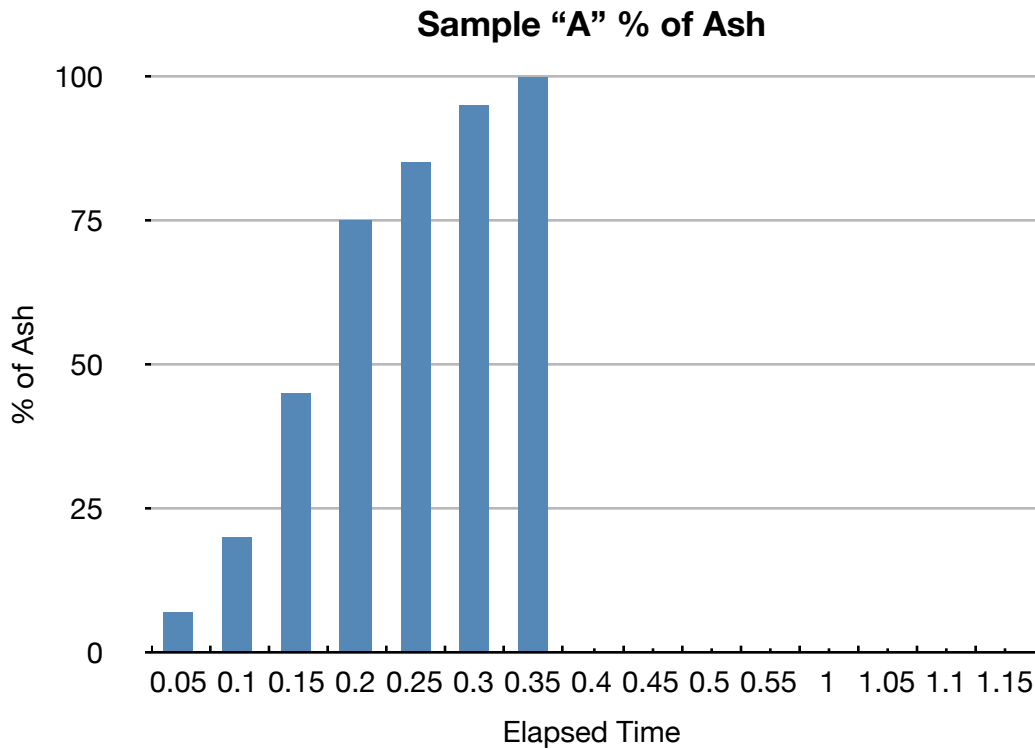
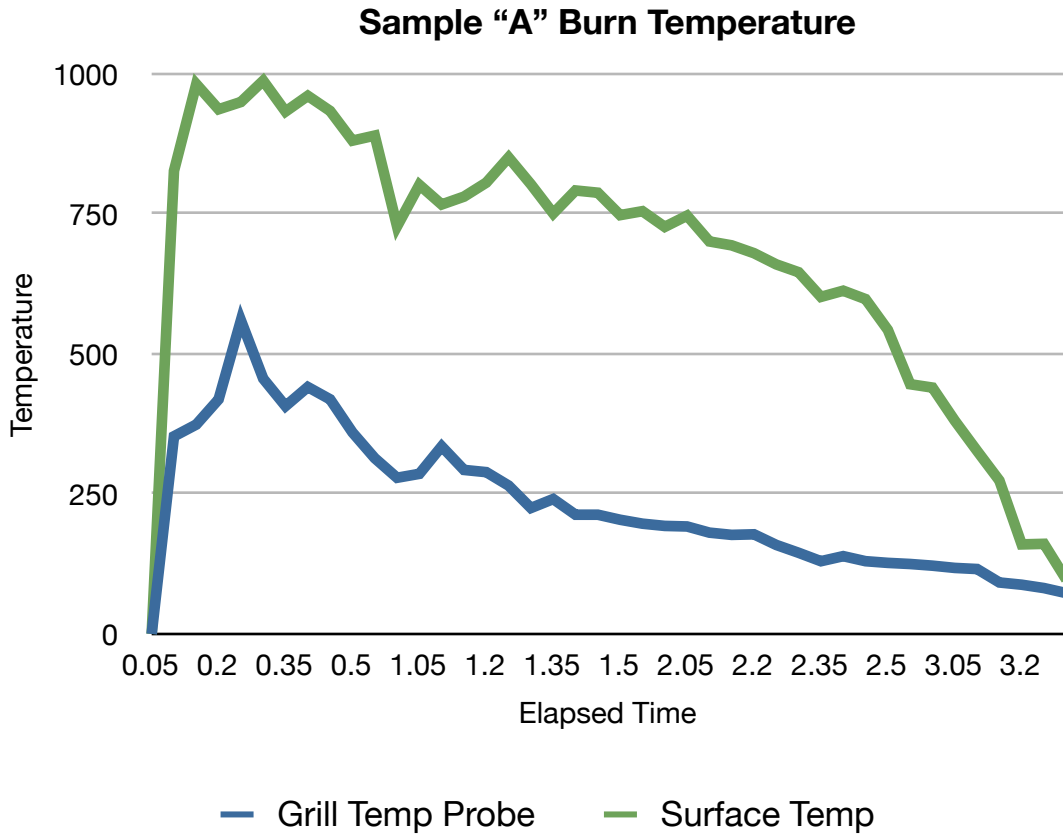
7. Observations

Various visual and odor observations were made during testing.

8. Test Data

Each sample was tested consecutively in intervals of three data collection periods. The highest performing result was selected for comparison and presented within this report.

SAMPLE "A" TEST DATA



BURN TEST SAMPLE "A" TEMP & ASH

<u>TIME</u>	<u>GRILL PROBE TEMP</u>	<u>SURFACE TEMP</u>	<u>% ASH</u>	<u>COMMENTS</u>
0:00	57	--	--	Ignition - Flame on
0:05	--	--	7	
0:07	--	--	--	Probe on - Flame off
0:10	353	827	20	
0:15	374	982	45	
0:15:15	--	--	--	Re ignition
0:20	419	937	75	
0:25	560	950	85	
0:30	456	988	95	
0:35	407	933	100	All Ash
0:40	441	961		
0:45	419	934		
0:50	360	881		
0:55	314	890		
1:00	279	728		
1:05	286	802		Ash starting to slough off briquettes onto bottom of grill
1:10	335	767		
1:15	293	781		
1:20	289	806		
1:25	265	851		
1:30	225	803		
1:35	241	751		
1:40	213	792		
1:45	213	787		
1:50	204	748		
1:55	197	755		
2:00	193	727		
2:05	192	747		
2:10	181	701		End of optimum cooking temp
2:15	177	694		
2:20	178	680		
2:25	159	660		
2:30	145	646		
2:35	130	602		
2:40	139	613		
2:45	130	598		
2:50	127	543		
2:55	125	446		
3:00	122	440		
3:05	118	381		
3:10	116	327		
3:15	92	274		
3:20	88	160		
3:25	82	131		
3:30	73	97		

SAMPLE "A" PHOTOGRAPHIC DOCUMENTATION



0:00 hr. Application of
100 ml lighter fluid



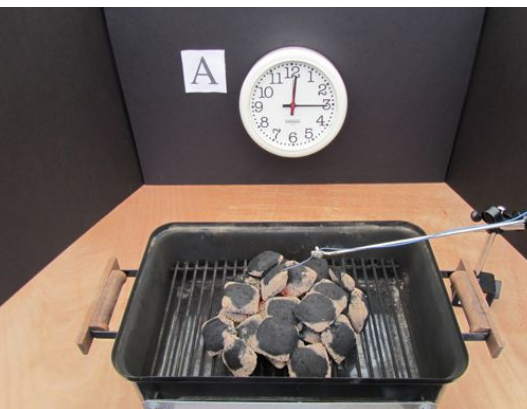
0:00 hr. Ignition



0:05 hr. 7% Ash



0:10 hr. Grill Probe On
20% Ash



0:15 hr. 45% Ash



0:20 hr. 75% Ash



0:25 hr. 85% Ash



0:30 hr. 95% Ash



0:35 hr. 100% Ash



0:40 hr.



0:50 hr.



1:00 hr.



1:10 hr.



1:20 hr.



1:30 hr.



1:40 hr.



1:50 hr.



2:00 hr.



2:10 hr.



2:20 hr.



2:30 hr.



2:40 hr.



2:50 hr.



3:00 hr.



3:10 hr.



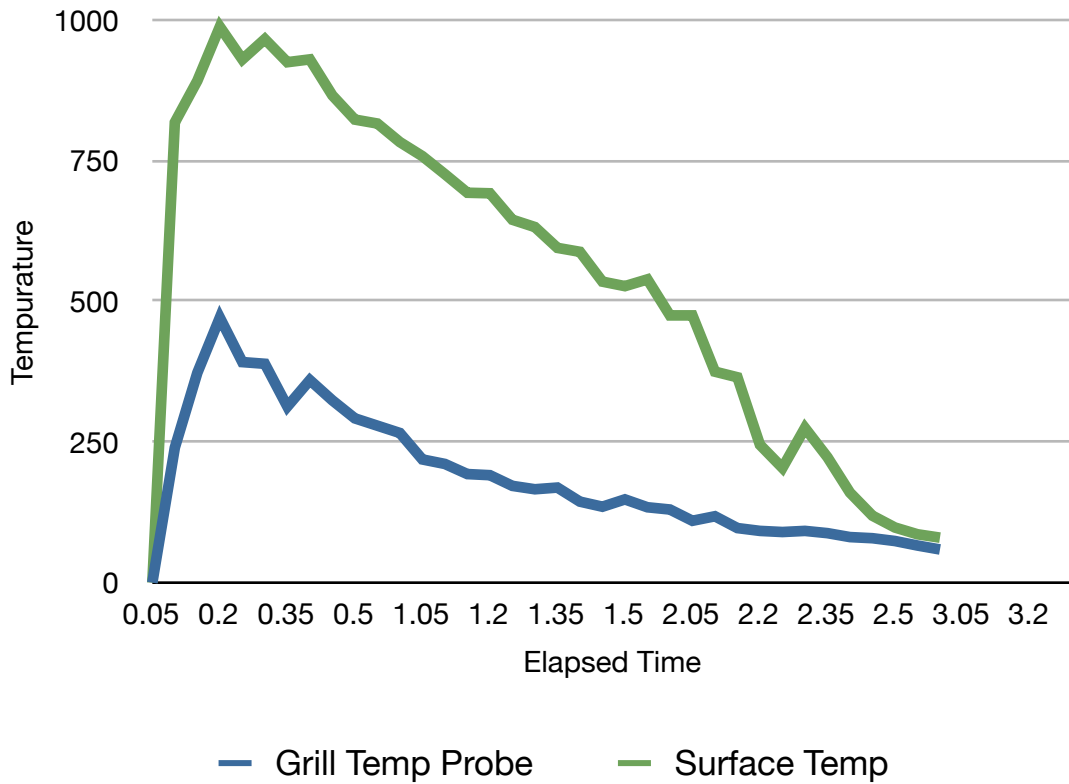
3:20 hr.



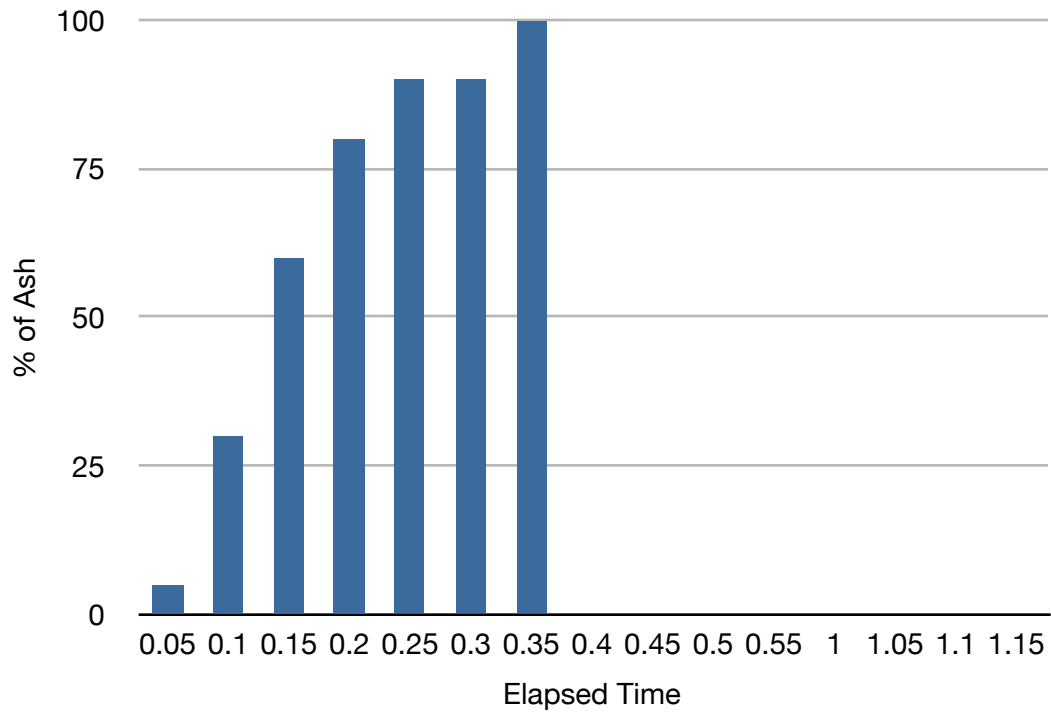
3:30 hr.
End Test

SAMPLE "B" TEST DATA

Sample "B" Burn Temperatures



SAMPLE "B" % of ASH



BURN TEST SAMPLE "B" TEMP & ASH

<u>TIME</u>	<u>GRILL PROBE TEMP</u>	<u>SURFACE TEMP</u>	<u>% ASH</u>	<u>COMMENTS</u>
0:00	55	--	--	Ignition - Flame on
0:05	--	--	5	
0:06	--	--	--	Probe on - Flame off
0:10	240	818	30	
0:15	373	892	60	
0:17	--	--	--	Flame on
0:20	471	988	80	Strong odor
0:25	392	930	90	
0:30	389	966	95	
0:35	313	925	100	All ash
0:40	360	930		
0:45	324	866		
0:50	292	823		
0:55	279	816		
1:00	266	783		
1:05	219	758		
1:10	211	726		Ash breaking
1:15	193	693		
1:20	191	692		End of optimum cooking temp
1:25	172	645		
1:30	166	632		
1:35	169	595		
1:40	144	588		
1:45	135	535		
1:50	148	527		
1:55	134	539		
2:00	130	475		
2:05	110	475		
2:10	118	375		
2:15	97	365		
2:20	92	245		
2:25	90	204		
2:30	92	275		
2:35	88	223		
2:40	81	160		
2:45	79	119		
2:50	74	98		
2:55	66	86		
3:00	59	80		
3:05				
3:10				
3:15				
3:20				
3:25				
3:30				

SAMPLE "B" PHOTOGRAPHIC DOCUMENTATION



0:00 hr. Application of
100 ml Lighter Fluid

0:00 hr. Ignition

0:05 hr 5% Ash



0:10 hr. Grill Probe on
30% Ash

0:15 hr. 60% Ash

0:20 hr. 80% Ash
Strong Odor



0:25 hr. 90% Ash

0:30 hr. 95% Ash

0:35 hr. 100% Ash



0:40 hr.



0:50 hr.



1:00 hr.



1:10 hr.



1:20 hr.



1:30 hr.



1:40 hr.



1:50 hr.



2:00 hr.



2:10 hr.



2:20 hr.



2:30 hr



2:40 hr.

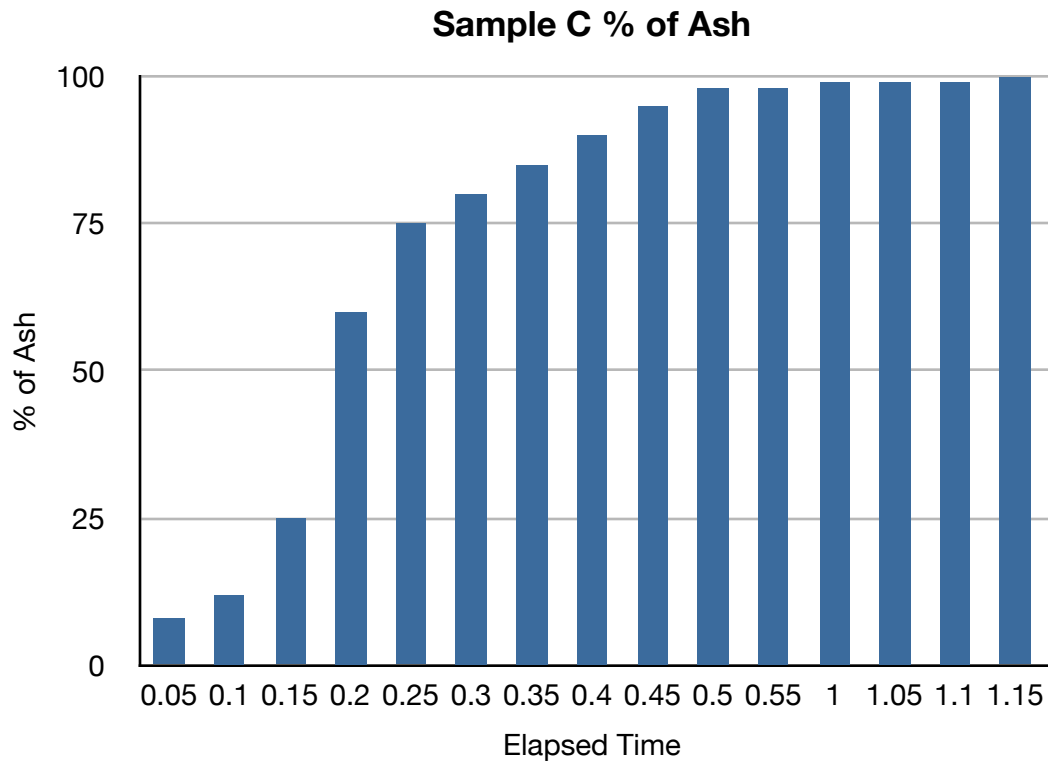
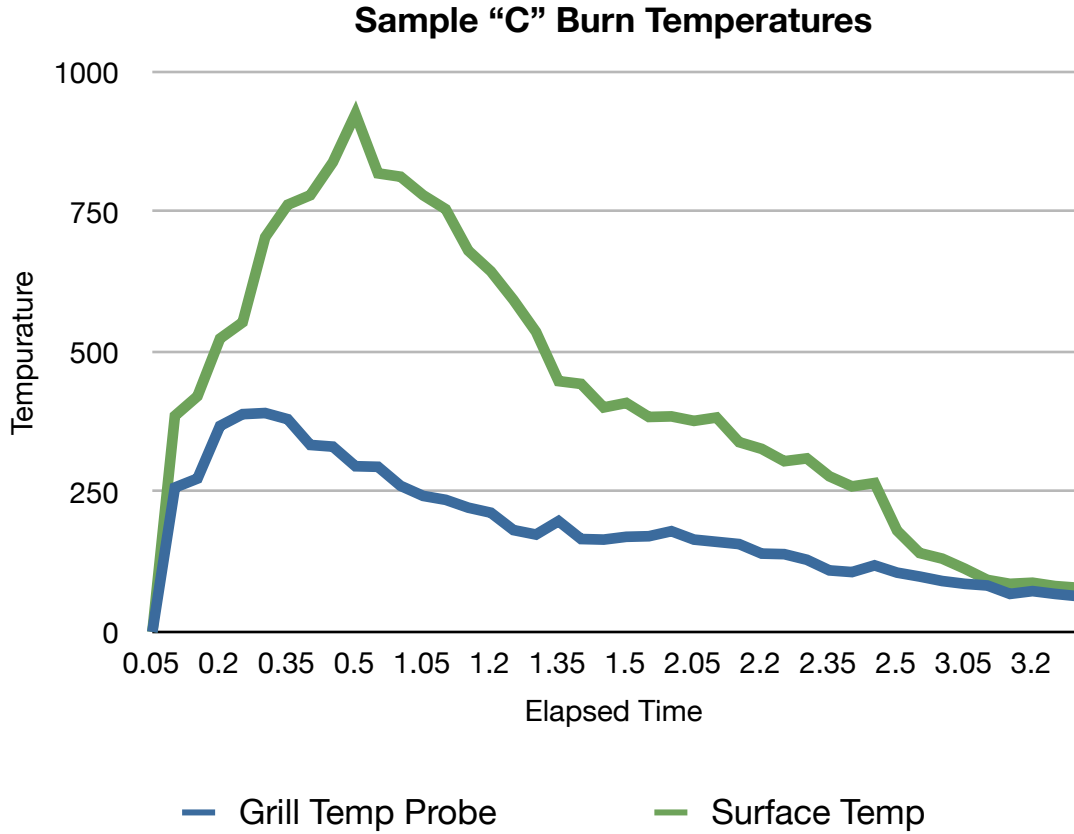


2:50 hr.



3:00 hr.
End Test

SAMPLE "C" TEST DATA



BURN TEST SAMPLE "C" TEMP & ASH

<u>TIME</u>	<u>GRILL PROBE TEMP</u>	<u>SURFACE TEMP</u>	<u>% ASH</u>	<u>COMMENTS</u>
0:00	57	--	--	Ignition - Flame on
0:05	--	--	8	Strong odor - Sparks
0:06:30	--	--	--	Probe on - Flame off
0:10	258	386	12	
0:15	274	421	25	
0:20	368	524	60	
0:25	389	553	75	
0:30	391	705	80	
0:33	--	--	--	Flame on
0:35	380	763	85	
0:40	334	780	90	
0:45	331	839	95	
0:50	296	925	98	
0:55	295	819	98	
1:00	261	813	99	
1:05	243	780	99	
1:10	236	755	99	
1:15	222	681	100	All ash
1:20	213	644		
1:25	182	593		End of optimum cooking temp
1:30	174	536		
1:35	179	448		
1:40	166	443		
1:45	165	401		
1:50	170	409		
1:55	171	384		
2:00	180	385		
2:05	165	377		
2:10	161	383		
2:15	157	339		
2:20	140	327		
2:25	139	305		
2:30	129	310		
2:35	110	278		
2:40	107	260		
2:45	119	266		
2:50	106	181		
2:55	99	141		
3:00	91	131		
3:05	86	113		
3:10	83	93		
3:15	68	86		
3:20	73	88		
3:25	68	82		
3:30	64	79		

SAMPLE "C" PHOTOGRAPHIC DOCUMENTATION



0:00 hr. Application of
100 ml Lighter Fluid



0:00 hr. Ignition



0:05 hr. 8% Ash
Briquettes Sparking
Strong Odor



0:10 hr. 12% Ash



0:15 hr. 25% Ash



0:20 hr. 60% Ash



0:25 hr. 75% Ash



0:30 hr. 80% Ash



0:35 hr. 85% Ash



0:40 hr. 90% Ash



0:50 hr. 98% Ash



1:00 hr. 99% Ash



1:10 hr. 99% Ash



1:20 hr. 100% Ash



1:30 hr.



1:40 hr.



1:50 hr.



2:00 hr.



2:10 hr.



2:20 hr.



2:30 hr.



2:40 hr.



2:50 hr.



3:00 hr.



3:10 hr.



3:20 hr.



3:30 hr.
End Test

SAMPLE DESCRIPTION

