

## ***Visual Energy Flame Emission Test***

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### **Experimental Procedure**

In this test, a diverse assortment of salts were added to the control (methanol) to visually observe the energy levels of the mixed substance as a flame. This experiment revealed the visual effects of a quantum jump where atoms are excited enough through added energy - in this case the heat of the flames - to change colors. Observations of changes - or lack thereof - in flame color as the salts mixed to the control differ were recorded.

The first step for this experiment was to place two droppers full of methanol a watch glass. A match was then lit and set the methanol afire, recording observations of the color of the flame color. These steps were then repeated with the varieties of salts mixed into the methanol, individually. The varieties of salts include Lithium Chloride, Calcium Chloride, Calcium Carbonate, Potassium Chloride, Borax, Copper (II) Sulfate, and an unknown salt. In the end, an educated prediction pertaining to what the unknown salt was created with the observations previously recorded.

### **Observation And Data**

Starting with the methanol, a standard blue flame was lit but became yellow as the flame grew smaller. As the grainy salt of lithium chloride was added, red flickers were seen at the tip on top the blue base of the methanol flame. Calcium chloride had a similar reaction but the red tip was replaced with an orange tip which faded to yellow soon before the flame died. The calcium carbonate mixture had a similar reaction as the calcium chloride but the tip of the flame was only yellow. The potassium chloride mixture, on the other hand, had a very different reaction. Instead of only the tip of the flame differing from the blue base, this mixture had yellow and purple sparks within the blue base flame itself. The borax mixture was also very different than the previous salts. The flame was a light green with blue sparks. The blue sparks soon took over the whole flame where yellow sparks appeared. The borax flame then died as a yellow flame. Copper (II) Sulfate started with a standard blue base, turning green and dying out as an orange flame. The unknown substance was a standard blue flame but it contained green and orange sparks within the base.

	<u>Compound Name</u>	<u>Formula</u>	<u>Compound Texture</u>	<u>Flame Color</u>
	Control (Methanol)	CH <sub>3</sub> OH		Common blue with flickers of yellow as flames ended
1	Lithium Chloride	LiCl	Standard white powdery, grainy texture comparable to salt	Common blue base with red tip flickering discontinuously
2	Calcium Chloride	CaCl <sub>2</sub>	White clumpy texture, comparable to roughly smashed chalk	Common blue base with fading orange to yellow tip
3	Calcium Carbonate	CaCO <sub>3</sub>	White fine, coarse powder comparable to standard household baking soda	Common blue base with fading yellow tip
4	Potassium Chloride	KCl	White crushed, crystal like powder	Common blue flame with flickers of discontinuous purple and yellow
5	Borax	Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> * 10H <sub>2</sub> O	White fine, grainy powder with occasional clumps comparable to sugar	Light green flame, gaining blue sparks before turning blue and dying out as a yellow flame
6	Copper (II) Sulfate	CuCO <sub>4</sub>	Blue, crushed, crystal like powder	Starts with blue base, quickly turning green, dying out as a orange flame
7	Unknown		Standard white powdery, grainy texture comparable to salt	Common blue base with flickers of discontinuous green and orange

It seems that lithium chloride, calcium chloride and carbonate chloride are very similar not only with the names all pertaining chloride at the end, but also the mixture reactions. All three salt mixtures affected the tips of the flames. Potassium chloride was different then all the other salt mixtures, producing a purple spark that none of the other mixtures produced. The borax and copper (II) sulfate mixtures both produced green flames. The unknown mixture produced a flame that took similar characteristics to the borax and sulfate, leading to the conclusion that the unknown mixture may be a combination of the borax and sulfate. The unknown mixture took on a green color which only the borax and the sulfate salts created. It also had the similar reaction of creating flickers of different colors but it doesn't react exactly like the other mixtures. Unlike the borax, the unknown salt did not cause the flames to fade into another color but it did take on flickers of the yellow. Unlike the copper (II) sulfate, it did only have orange as one of it's flickering colors within the blue base flame.

## **Conclusion**

By using the data table, it can be concluded that the unknown substance seems to be Borax. The unknown produced a blue base that similar in every other flame. Within the blue base were sparks of green and orange. The lithium chloride, calcium chloride and carbonate chloride mixtures all produced variants of colors in the tip of the flame whereas the unknown mixture had sparks within the base of the flame. Since that left only borax and copper (II) sulfate to compare, the different colors that the flames produced was the deciding factor. Borax was the only chemical to generate a green flame-- similar to the unknown substance. To get extensive information and better evidence, it would be best to in the future compare these two substances side-by-side. By the end of the experiment it is clear that different chemical compounds produce diverse colors of light. When salts are burned photons are emitted which causes a frequency that that is high or low. This is a good technique to identify unknown substances.