CANDLE QUALITY CONTROL
RAW MATERIALS TO FINISHED PRODUCT

1st LATIN AMERICAN CANDLE MANUFACTURERS FORUM

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NOTES ON INFORMATION SUPPLIED IN THIS PRESENTATION

- All equipment information from Cole-Parmer 2011-2012 catalog
- Cole-Parmer has dealers throughout South and Latin America – go to www.coleparmer.com
- All costs listed for equipment are in US $
- Most of the equipment listed in this report is fairly inexpensive and/or can be used over and over again for testing, but some equipment is a little more costly. You will need to make a decision as to whether the more expensive equipment is worth the price.
- Some of the equipment that is called for in the standards is not required for your quick testing to ensure that you are getting the proper wax. However, you must realize that your results will not exactly match the stated results on the paperwork that you receive from your supplier if you do not use the equipment specified. You should keep records on your results with your method and note when something seems to be amiss.
CANDLE RAW MATERIALS

THREE BASIC MATERIALS ARE USED IN CANDLE MANUFACTURING THAT NEED TO BE QUALITY CONTROL CHECKED

- WAXES
- FRAGRANCES
- COLORANTS
WAX

- MELT POINT OF WAXES
  - ASTM D87 STANDARD TEST METHOD FOR MELTING POINT OF PETROLEUM WAX (COOLING CURVE)
    - THIS METHOD SHOULD ONLY BE USED FOR PURE PARAFFIN WAXES. IT IS NOT SUITABLE FOR PETROLATUM, MICROCRYSTALLINE OR BLENDS OF PARAFFIN WAXES WITH ANY OF THESE WAXES
      - IT DOES NOT WORK FOR THESE OTHER TYPES OF WAXES BECAUSE THERE IS NOT A DEFINED PLATEAU ON THE COOLING CURVE
    - DEFINITION - MELTING POINT OF PETROLEUM WAX - TEMPERATURE AT WHICH MELTED PETROLEUM WAX FIRST SHOWS A MINIMUM RATE OF TEMPERATURE CHANGE WHEN ALLOWED TO COOL UNDER PRESCRIBED CONDITIONS
  - EQUIPMENT
    - TEST TUBE - 25mm x 150mm PUREX BRAND 9800 Cat #S-34569-08 $129.00/72 pcs.
    - RUBBER STOPPER - #5 W/ONE HOLE Cat #S-06301-62 $60.50/50 pcs.
    - STIRRING MECHANISM (LIKE A COPPER WIRE)
    - AN AIR/WATER BATH IS CALLED FOR IN THE STANDARD, BUT FOR QUICK TEST PURPOSES, YOU CAN DO WITHOUT THIS EQUIPMENT
WAX

ASTM D87 (CON’T)

PROCEDURE

– HEAT WAX SAMPLE TO AT LEAST 8° C (15° F) ABOVE ITS MELTPOINT
– FILL TEST TUBE WITH HOT WAX TO A HEIGHT OF 51 mm
– INSERT THE THERMOMETER INTO THE STOPPER AND PUT THIS ASSEMBLY INTO THE TEST TUBE SUCH THAT THE BOTTOM OF THE THERMOMETER IS 10 mm FROM THE BOTTOM OF THE TEST TUBE.

– USING A COPPER WIRE AS A STIRRING ROD (STOPPER NEEDS TO BE NOTCHED OUT FOR THIS WIRE), STIR THE WAX, READING THE TEMPERATURE ON THE THERMOMETER EVERY 15 SECONDS.

– THE MELT POINT OF THE WAX IS THE POINT AT WHICH FIVE (5) CONSECUTIVE READINGS ARE WITHIN 0.1° C
CONGEAL POINT OF WAXES

- ASTM D938 STANDARD TEST METHOD FOR CONGEALING POINT OF PETROLEUM WAXES, INCLUDING PETOLATUM
  - THIS METHOD CAN BE USED WITH ANY KIND OF WAX OR WAX BLEND, INCLUDING NATURAL WAXES LIKE SOY/PALM
  - DEFINITION – CONGEALING POINT OF PETROLEUM WAX – THAT TEMPERATURE AT WHICH MOLTEN PETROLEUM WAX, WHEN ALLOWED TO COOL UNDER PRESCRIBED CONDITIONS, CEASES TO FLOW

EQUIPMENT

- EHRLENMEYER FLASK 125 ml PUREX VISEO FLASK CAT. #S34530-84 $64.76/24 pcs.
- RUBBER STOPPER – SAME AS FOR ASTM D 87
- THERMOMETER – ASTM 54 C CAT # S08009-30 $95.60 ea.
  ASTM 54 F CAT # S08009-31 $95.60 ea
PROcedure

- Position the thermometer in the stopper such that the bottom is 10-15 mm from the bottom of the flask.
- Heat the wax to at least 11°C (20°F) above its meltpoint.
- Heat the flask to a higher temperature than the meltpoint of the wax (probably in an oven).
- Dip thermometer bulb in the hot wax, being careful to only immerse the bulb and not any part of the stem.
- Allow the temperature of the thermometer to equilibrate with the hot wax.
- Remove the flask from the oven and the thermometer from the wax, being careful to keep a “relatively large drop” of wax on the bulb of the thermometer.
- With the thermometer held in a horizontal position, insert it into the warm flask.
- Keep this assembly in a horizontal position and observe the drop of wax on the bulb of the thermometer as the flask is rotated about its horizontal axis in a 2-3 second interval.
- When the drop is observed to rotate with the bulb, immediately record the temperature.
WAX

- DROP POINT OF WAXES
  - ASTM D127 STANDARD TEST METHOD FOR DROP MELTING POINT OF PETROLEUM WAX INCLUDING PETROLATUM
    - THIS METHOD PRIMARILY IS USED FOR PETROLATUMS AND OTHER MICROCRYSTALLINE WAXES (I REGULARLY USE THIS METHOD TO CHECK ALL INCOMING WAXES INCLUDING PARAFFINS)
    - DEFINITION – DROP MELTING POINT OF PETROLEUM WAX, THE TEMPERATURE AT WHICH MATERIAL BECOMES SUFFICIENTLY FLUID TO DROP FROM THE THERMOMETER USED IN MAKING THE DETERMINATION UNDER DEFINITE PRESCRIBED CONDITIONS.
  - EQUIPMENT
    - TEST TUBES – SAME AS FOR ASTM D87
    - BATH – AT LEAST 1500 ml PUREX BRAND 1000 BEAKERS CAT # S34502-12 $63.00/4 pcs.
    - THERMOMETERS ASTM 61 C OR ASTM 61 F (THESE ARE NOT AVAILABLE FROM COLE-PARMER)
    - HOT PLATE OR BUNSEN BURNER TO HEAT THE WATER BATH
WAX

- ASTM D127 (CON’T)
  - **PROCEDURE**
    - HEAT THE SAMPLE OF WAX TO AT LEAST 11º C (20º F) ABOVE ITS MELTPOINT
    - COOL THE THERMOMETER WITH STOPPER TO 4º C (40º F)
    - REMOVE THE THERMOMETER/STOPPER FROM THE COOLER, WIPE THE BULB DRY AND IMMEDIATELY IMMERSE THE BULB INTO A TRAY OF HOT WAX THAT IS 12+/-- 1mm DEEP UNTIL IT TOUCHES THE BOTTOM. IMMEDIATELY WITHDRAW THE THERMOMETER FROM THE WAX.
    - PUT THE DIPPED THERMOMETER/STOPPER INTO A TEST TUBE SUCH THAT THE BOTTOM OF THE THERMOMETER IS 15 mm ABOVE THE BOTTOM OF THE TEST TUBE.
    - PLACE THE TEST TUBE IN A WATER BATH AND HEAT UP THE WATER AT 3º F/MINUTE INITIALLY UP TO 100º F, THEN 2º F/MINUTE THEREAFTER UNTIL THE FIRST DROP OF WAX DROPS OFF OF THE THERMOMETER. RECORD THE TEMPERATURE ON THE THERMOMETER WHEN THIS OCCURS.
OTHER QUALITY CONTROL PROCEDURES

- NEEDLE PENETRATION (HARDNESS)
  - CAT #S59860-30 $2182.00

- DIFFERENTIAL SCANNING CALORIMETER OR DSC (MELT POINT) (NOT AVAILABLE FROM COLE-PARMER, BUT THIS EQUIPMENT IS VERY EXPENSIVE)

- VISCOSITY
FRAGRANCE

- **REFRACTIVE INDEX**
  - Refractometers measure the degree to which the light entering a liquid changes direction.
  - Each fragrance has its own refractive index; measurable to the fourth decimal point, i.e. .0000.
  - Very small deviations from one lot to another, i.e. 1.3333+/-.0020.
  - **Equipment**
    - “Digital Laboratory Refractometer” 1.330-1.5318  Cat # S-02941-34  $730.00
    - “Reichert Full-Range Digital Refractometer” 1.3300-1.5600  Cat # S-81030-00  $1195.00

- **COLOR**
  - Observe the actual color of the raw fragrance.
  - Determine if this color is going to be a problem in the finished candle color (if that is known).
  - Retain samples in 4 oz. glass jars for reference.
  - Glass jars should have a “PTFE” plastic liner to prevent interaction between the fragrance chemicals and the plastic lid.
  - Maintain retain samples for at least one year (longer if possible).
  - Keep the original lab sample (or a sample from the first order) for as long as that fragrance is being used in production (for reference).
FRAGRANCE**

- **SOLUBILITY**
  - **IN HOT WAX**
    - PUT THE FRAGRANCE INTO HOT WAX AT THE % DESIRED AND MIX FOR FIVE (5) MINUTES
    - LOOK FOR CLOUDINESS, PARTICULATES OR OIL-LIKE DROPLETTES ON THE BOTTOM OF THE CONTAINER. IF THESE ARE FOUND, THE SAMPLE SHOULD BE REJECTED
  - **IN COLD WAX**
    - POUR A CANDLE FROM THE HOT WAX SOLUBILITY TEST AND LET IT COOL. OBSERVE ANY OIL RESIDUE ON THE CANDLE OR ANYTHING ELSE THAT LOOKS SUSPICIOUS. IF THERE IS ANY RESIDUE ON THE CANDLE AFTER IT IS COOLED, THE FRAGRANCE SHOULD BE REJECTED.

*THESE TESTS ARE NORMALLY USED FOR R&D PURPOSES*

- **ODOR**
  - EVALUATE THE ODOR OF THE FRAGRANCE WHEN IT ARRIVES AND COMPARE IT TO THE STANDARD
  - **COLD THROW**
    - EVALUATE THE COLD THROW OF THE FRAGRANCE FROM THE CANDLE ABOVE
  - **HOT THROW**
    - BURN THE CANDLE TO CHECK ON ITS HOT THROW WHILE BURNING

**A SAMPLE FRAGRANCE EVALUATION FORM IS ATTACHED**
FRAGRANCE

- **BURN TEST**
  - THE WAX FROM THE SOLUBILITY TEST SHOULD BE POURED INTO A STANDARD CONTAINER (FOIL CUP OR A SMALL GLASS CONTAINER) WITH A STANDARD WICK APPROPRIATE FOR THIS CONTAINER. THE CANDLE SHOULD BE BURN TESTED TO DETERMINE IF THERE ARE ANY PROBLEMS WITH THE FRAGRANCE.
  - **BURN PROBLEMS**
    - FLAME HEIGHT DIMINISHES DURING THE BURN TEST
    - FLAME HEIGHT VERY SMALL
    - FLAME GOES OUT DURING THE BURN TEST

**IF ANY OF THESE PROBLEMS ARE NOTED, AN ASSESSMENT SHOULD BE MADE AS TO WHETHER TO GO WITH A LARGER WICK TO TRY AND OVERCOME THE PROBLEM OR TO ASK THE FRAGRANCE SUPPLIER TO REFORMULATE THE FRAGRANCE.**
COLORANTS

- **DYES AND PIGMENTS**
  - RETAIN A STANDARD BY WHICH YOU CAN COMPARE ALL INCOMING SHIPMENTS
  - MAKE UP A SMALL (100 gm) BATCH OF EACH OF THE LOTS OF DYE OR PIGMENT (THE STANDARD AND THE INCOMING LOT) USING SOME SMALL AMOUNT OF COLORANT FOR EACH BATCH, i.e., .1 gm per 100 gms wax
  - CHECK THE INCOMING LOT AGAINST THE STANDARD LOT FOR THE FOLLOWING CHARACTERISTICS BY POURING A PLAQUE (FOR DYES) OR DIPPING A CANDLE (IF A PIGMENT IS BEING TESTED)
    - COLOR STRENGTH – IF THE SAMPLE IS LIGHTER OR DARKER, DETERMINE THE DEGREE OF VARIATION AND CONTACT THE SUPPLIER IF APPROPRIATE
    - COLOR HUE – IF THE COLOR IS DIFFERENT IN HUE, CONTACT THE SUPPLIER TO DETERMINE WHAT TO DO WITH THIS LOT OF DYE
FINISHED PRODUCTS

FINISHED PRODUCTS SHOULD BE CHECKED ON A ROUTINE BASIS FOR BURNING CHARACTERISTICS AND ON A PERIODIC BASIS FOR SHELF STABILITY ISSUES

- **BURN TESTS**
  SHOULD BE CONDUCTED IN 4 HOUR INCREMENTS WITH HOURLY MONITORING. WICKS SHOULD BE TRIMMED IF THE LABEL CALLS FOR TRIMMING BEFORE EACH BURN INTERVAL IS STARTED. EACH BURN INTERVAL SHOULD BE MONITORED FOR THE FOLLOWING CHARACTERISTICS
  - FLAME HEIGHT
    - NO MORE THAN 3 INCHES (???????????????????????)
  - SECONDARY IGNITION
    - NOTHING OTHER THAN THE PRIMARY WICK(S) CAN SUPPORT A FLAME; ie, paint, decals, embeds, pieces of wick, etc.
  - END OF USEFUL LIFE – WHEN THE CANDLE CEASES TO SUPPORT COMBUSTION AND THE CANDLE FLAME(S) GOES (GO) OUT ON ITS OWN, AS DESIGNED, AND CANNOT BE RE-LIT..
    - DOES NOT CRACK OR BREAK THE CONTAINER, DOES NOT EXHIBIT EXCESSIVE FLAME HEIGHT AND DOES NOT EXHIBIT SECONDARY IGNITION FOR FILLED AND VOTIVE CANDLES AND TEALIGHT ENSEMBLES AND THE FLAME DOES NOT IMPINGE ON THE SUPPORTING SURFACE FOR A FREESTANDING CANDLE

**A SAMPLE BURN TEST REPORT IS ATTACHED AND IS BASED ON THE REQUIREMENTS OF THE ASTM CANDLE FIRE SAFETY STANDARDS**
FINISHED PRODUCTS

- **CANDLE STABILITY**
  - All freestanding and filled candles, including all ensembles of all types of candles, should not tip over when put on a 10° incline before the candle is burned.
  - All freestanding candles should not tip over while being burned on a flat surface.

- **SHELF STABILITY**
  - All candles should be tested for fade resistance by subjecting them to a light test**.
  - All candles should be shelf tested (under normal temperature conditions) for 3 months – candles should be checked monthly for any signs of change.
  - All candles (especially those containing fragrance) should be tested at an elevated temperature (90-95°F) for a period up to 7 days. Check these candles for:
    - Fragrance migration – oil on the surface or top of the candle
    - Color change and/or discoloration
    - Color bleeding onto packaging materials
    - Any other adverse reaction

**Light test equipment and procedure attached for your use**
I WANT TO THANK ALAFAVE AND ABRAFAVE FOR THIS OPPORTUNITY TO SPEAK TO YOU, THEIR MEMBERS, ON THE IMPORTANCE OF USING QUALITY RAW MATERIALS TO MAKE GOOD QUALITY CANDLE PRODUCTS. MY GOAL WAS TO IMPART SOME OF THE KNOWLEDGE THAT I HAVE GAINED OVER MANY YEARS OF WORKING IN THE CANDLE LAB DOING THE TESTS I HAVE DESCRIBED FOR YOU. HOPEFULLY YOU HAVE LEARNED SOMETHING ABOUT HOW TO TEST YOUR RAW MATERIALS TO MAKE SURE THEY ARE THE CORRECT MATERIALS AND THAT THEY MEET THE STANDARD REQUIREMENTS SO YOU CAN MAKE A QUALITY PRODUCT TIME AFTER TIME. ALSO, I WANT TO EMPHASIZE THAT YOU MUST ALSO TEST YOUR FINISHED PRODUCT TO ENSURE THAT YOUR CUSTOMERS ARE RECEIVING QUALITY CANDLES.

IF THERE ARE ANY QUESTIONS, I WILL BE HAPPY TO TRY TO ANSWER THEM.

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