

Material Change Similarity

Status Update

IAMFTWG

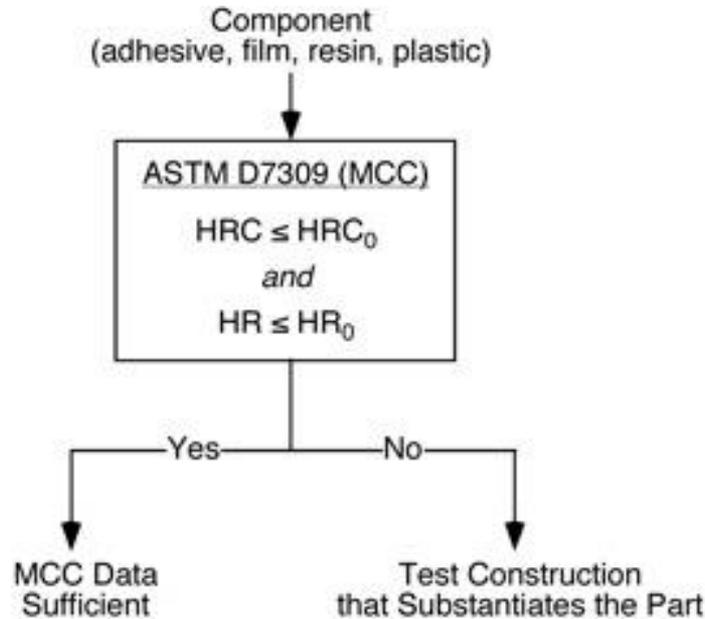
Mobile, Alabama

March 7th, 2017

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Problem: HR and HRC are not independent

$$HRC = \frac{HR}{\Delta T}$$

Background:

- MCC was proposed to determine similarity at the material level when small changes are made to certified materials.
- MCC guidance document was posted on FAA website on June 2016
- Decision flow chart includes 2 MCC parameters HRC and HR
- The proposed basis for comparing HRC and HR was the reproducibility limit from the ASTM D 7309 standard

Propose Single MCC Criterion for Small Change (Requires Verification by Industry)

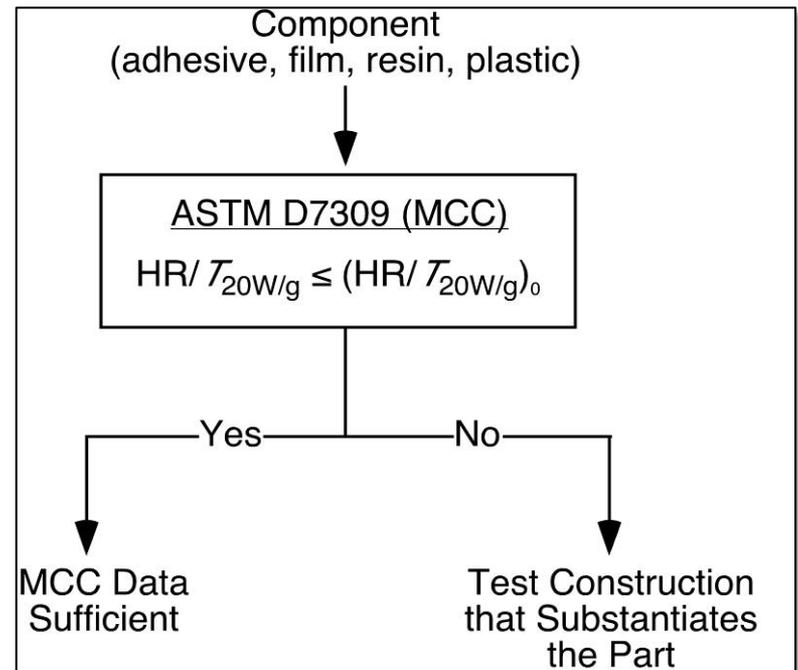
$$\text{Ignition Capacity} = \frac{\text{Heat Released by Combustion}}{\text{Heat Needed to Gasify Plastic}} \approx \frac{\text{HR}}{T_{20\text{W/g}}(\text{°C})}$$

- Heat release (HR) and ignition temperature ($\approx T_{20\text{W/g}}$) are independent properties
- Both are important for flammability
- Both are easy to measure in MCC

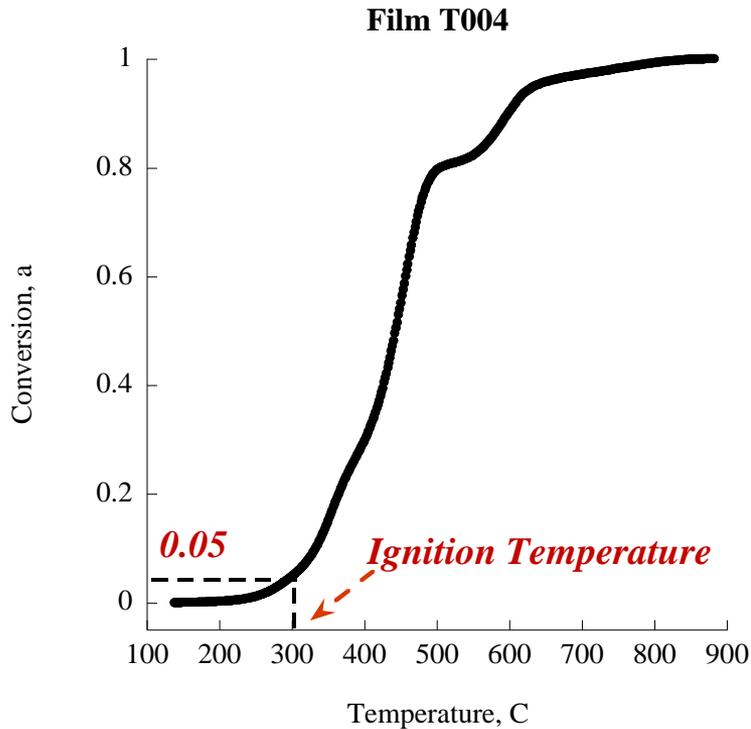
$$\text{Tolerance} = \sqrt{\sigma_{\text{HR}}^2 + \sigma_{T_{20\text{W/g}}}^2} = \pm 6\%$$

$\sigma_{\text{HR}} = 5.9\%$ ASTM repeatability

$\sigma_T = 1.2\%$ ASTM repeatability

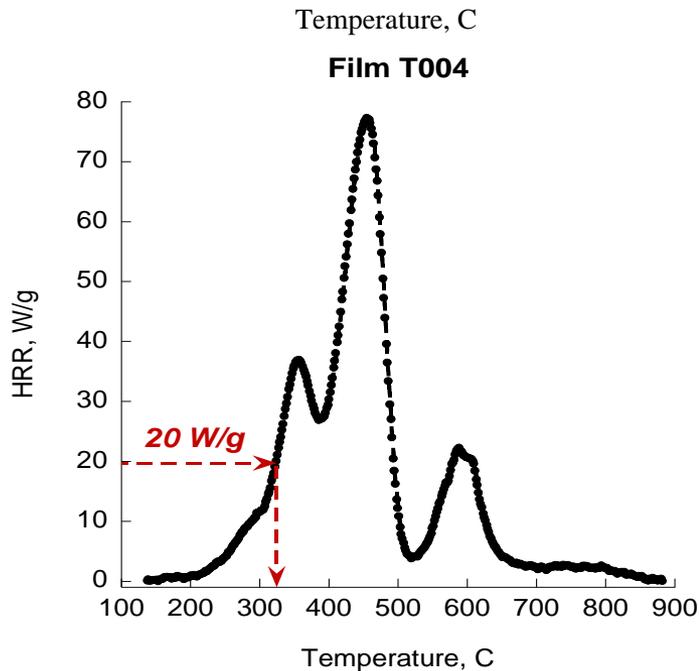


Possible methods to determine T_{ign}



Procedure:

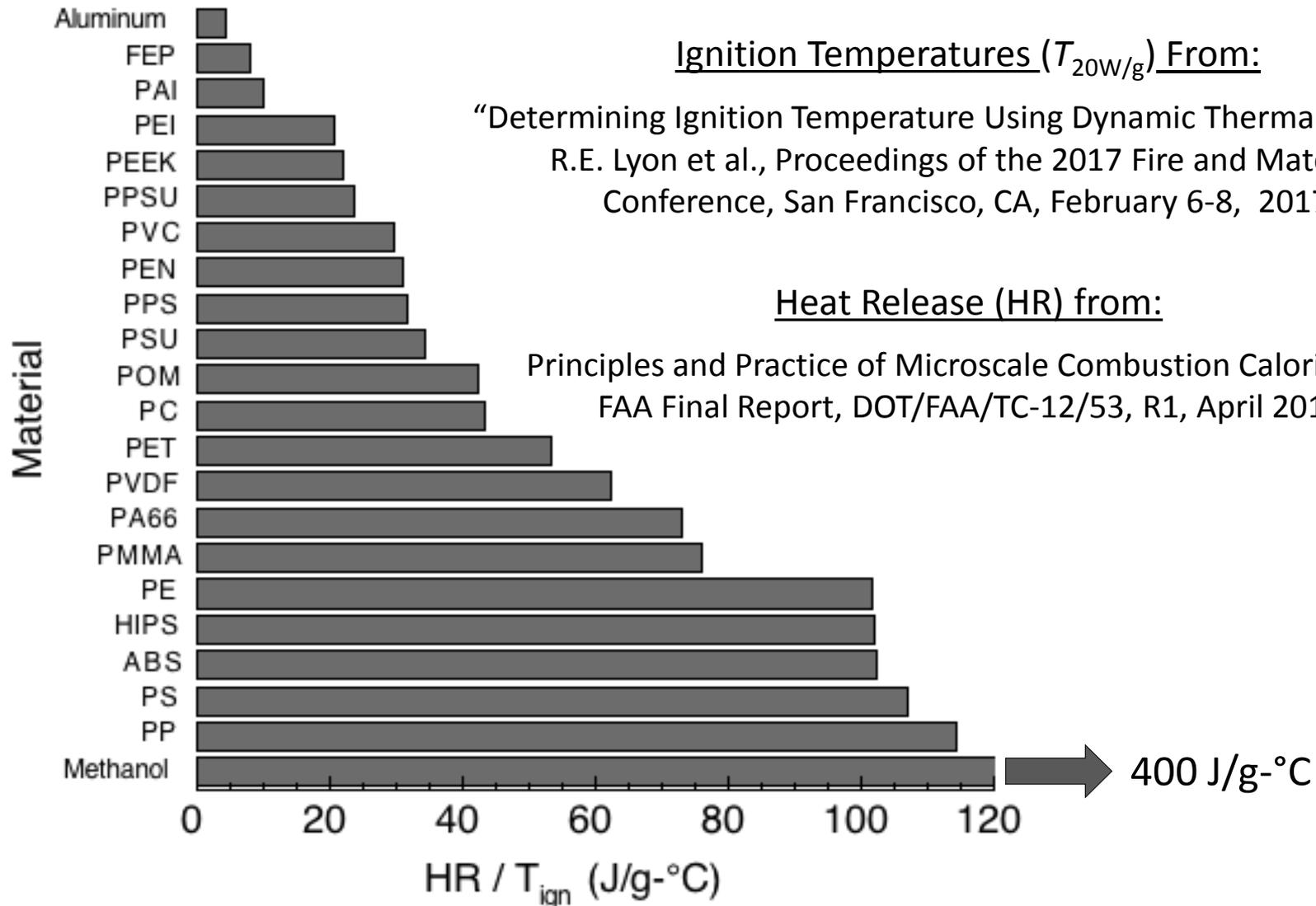
- ✓ Integrate HRR vs time (curve)
- ✓ Derive by C max (to get 0 to 1 scale)
- ✓ Find value corresponding to 0.05
- ✓ Record T
- ✓ T_{ign} 302⁰C



Procedure:

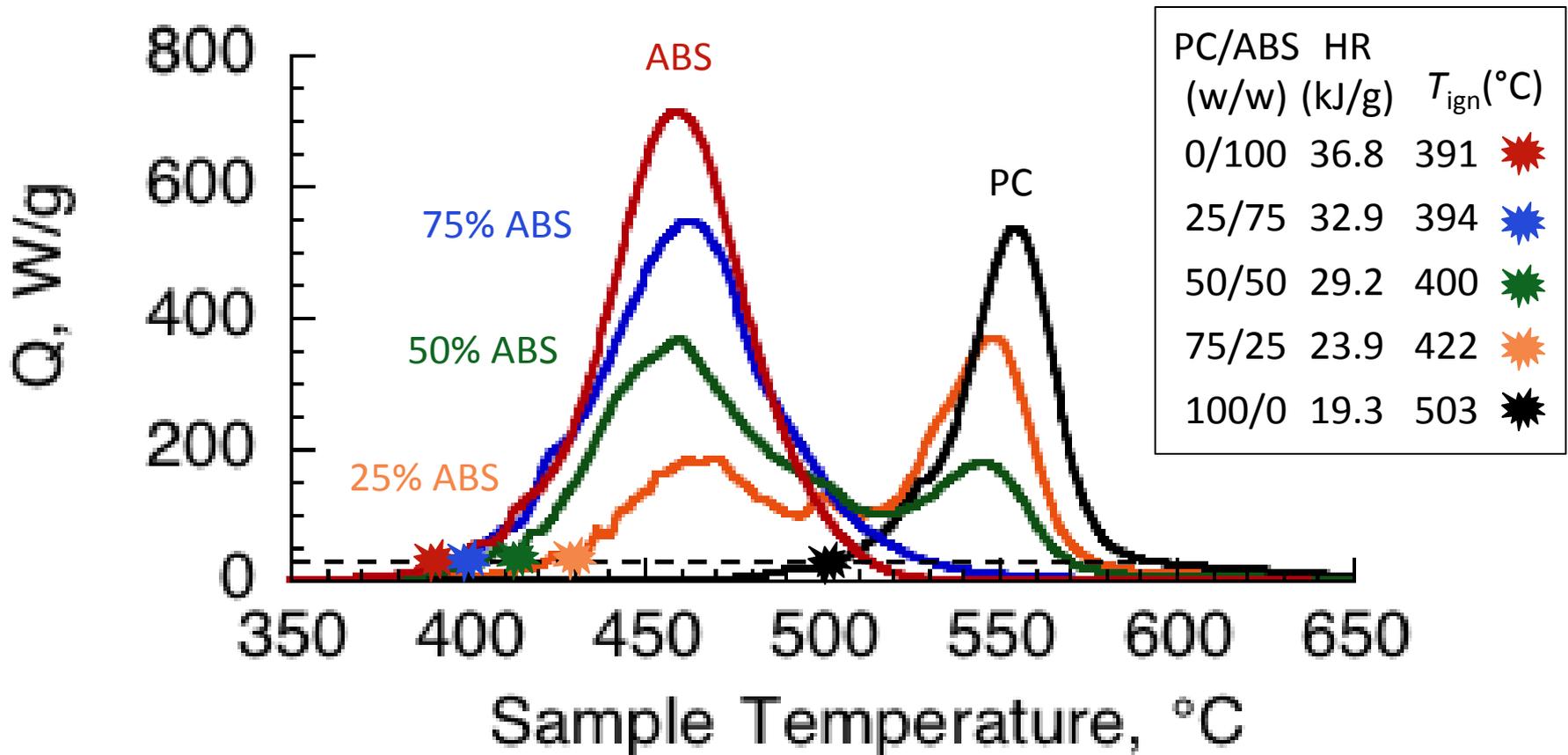
- ✓ Plot HRR versus T from MCC experiment
- ✓ Find value corresponding to 20 W/g
- ✓ Record T
- ✓ T_{ign} 325⁰C

Ignition Capacity (HR/T_{ign}) of Common Materials



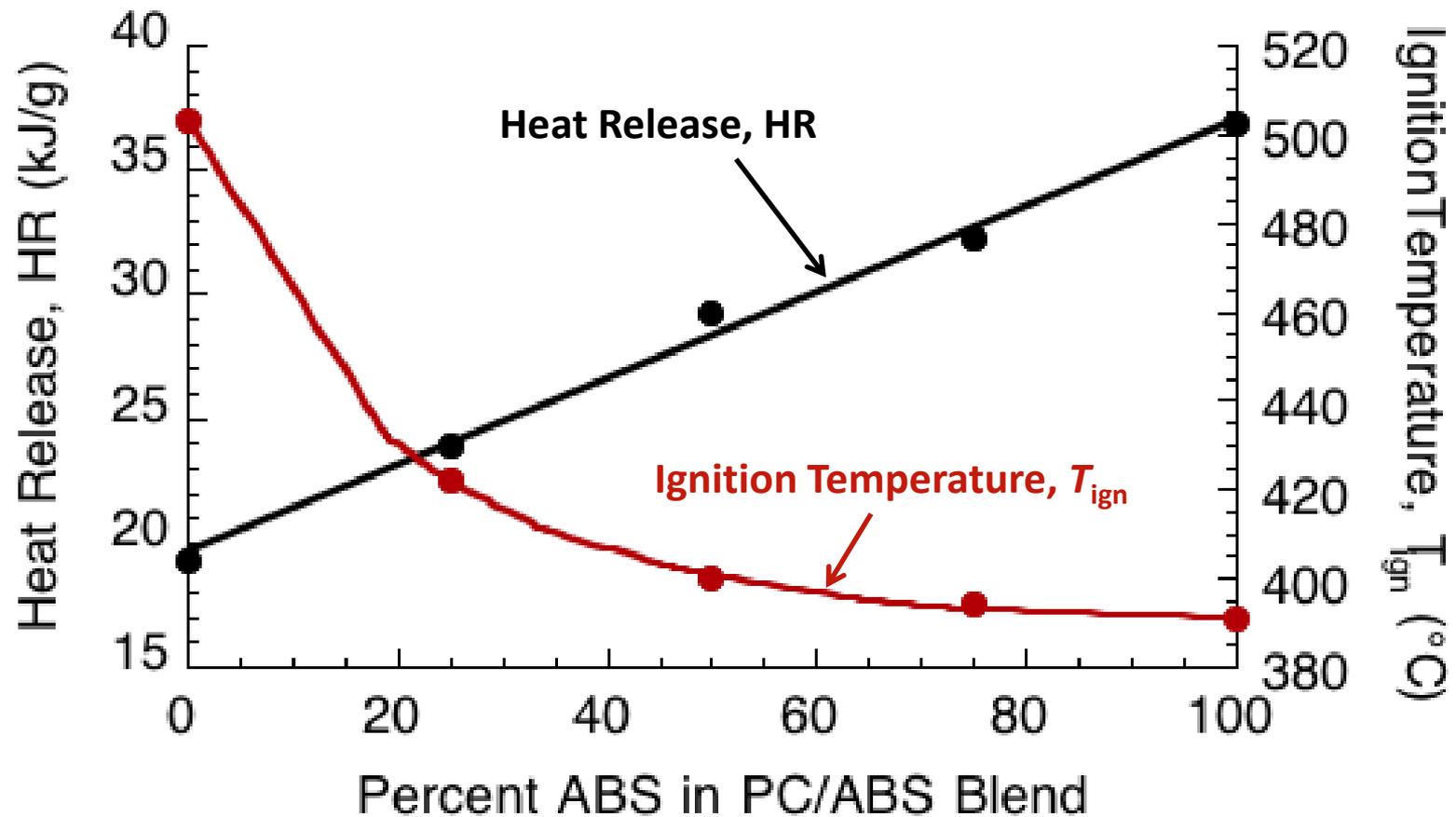
MCC Data for PC/ABS Blends

Large Changes in HRR Signature, HR & T_{ign}



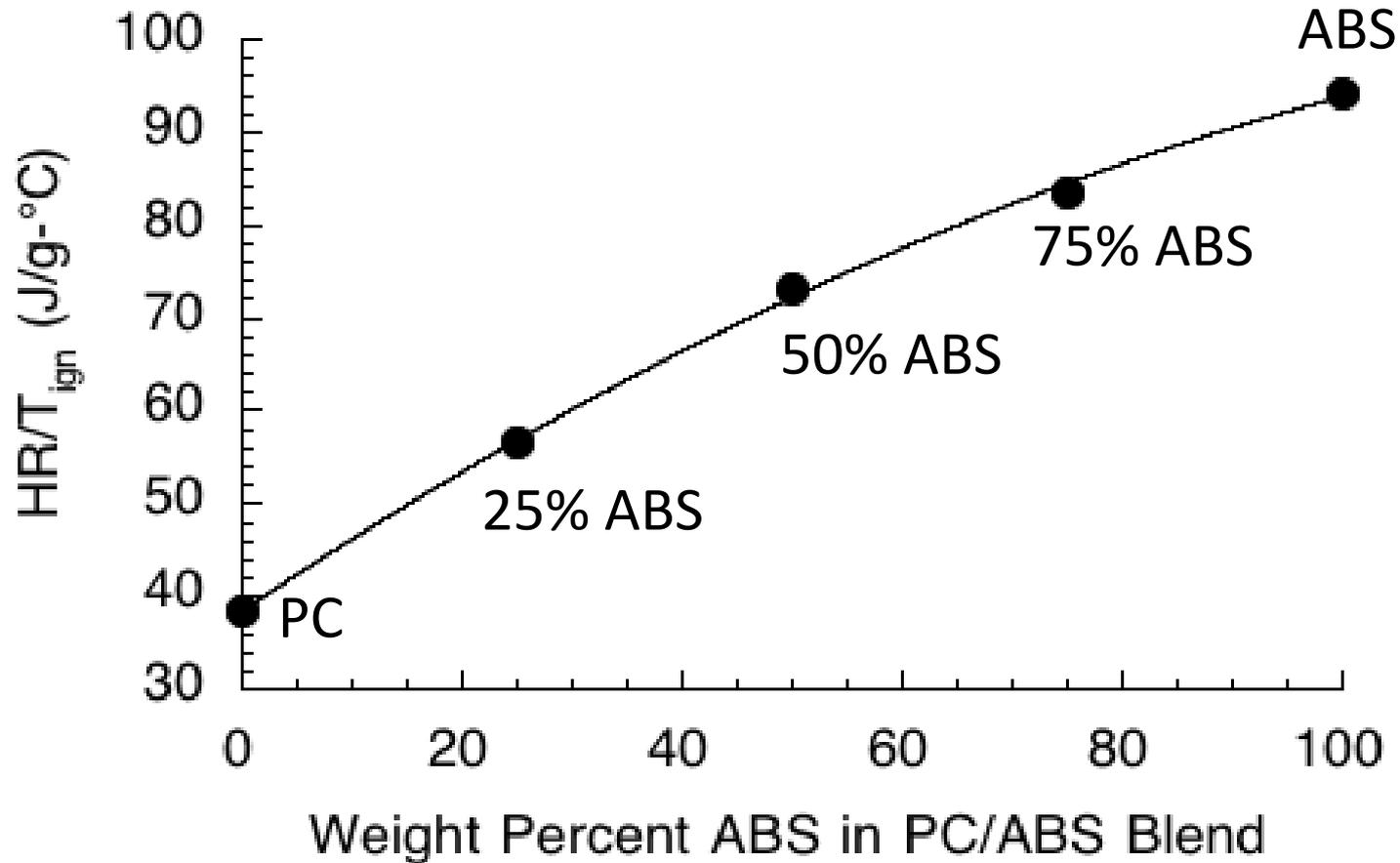
MCC Data for PC/ABS Blends

Large Changes in HR and T_{ign}

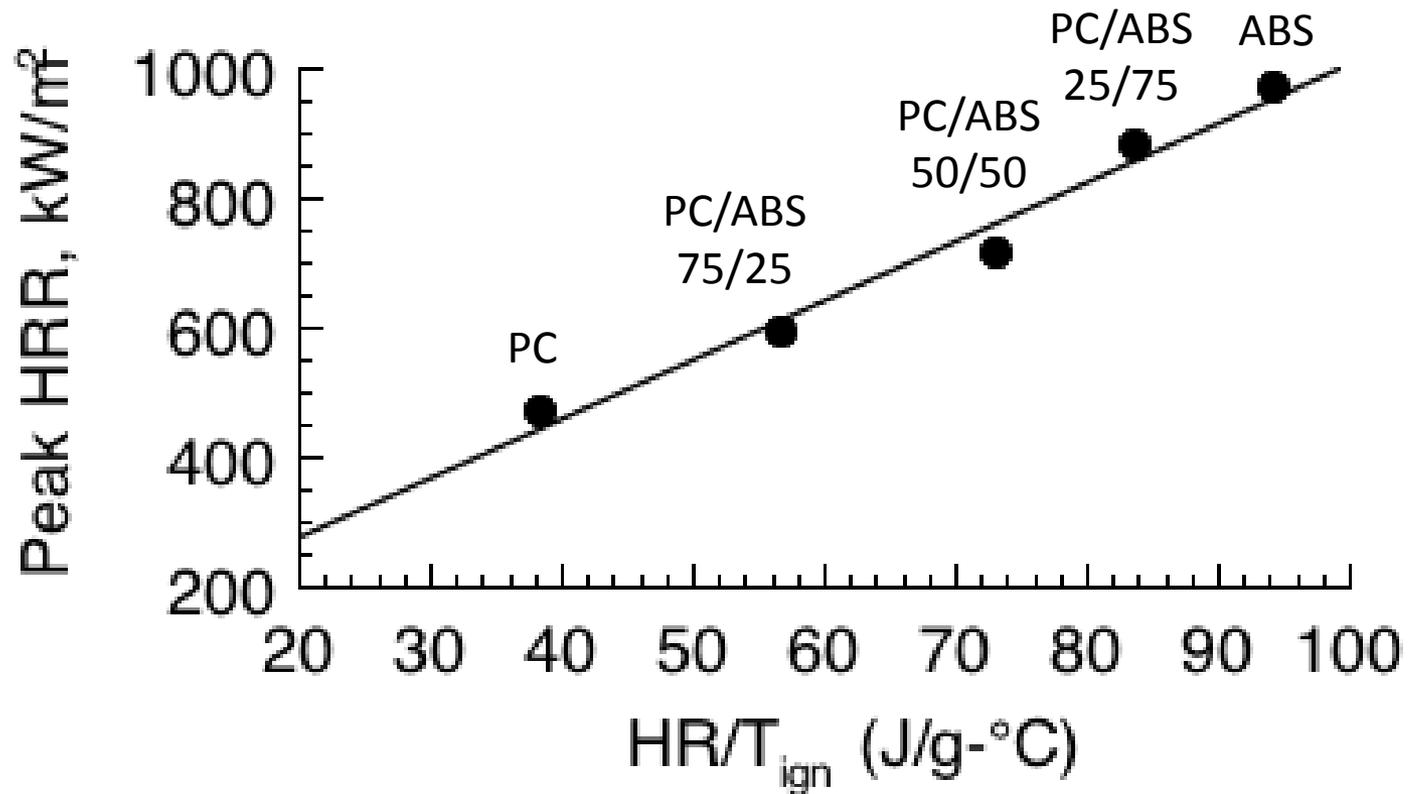


MCC Data for PC/ABS Blends

Large Changes in HR/T_{ign}



PC/ABS Blends (3-mm) in Cone Calorimeter At 35 kW/m² External Heat Flux



Re-Examine Data from Previous Study to Substantiate Paint Colors

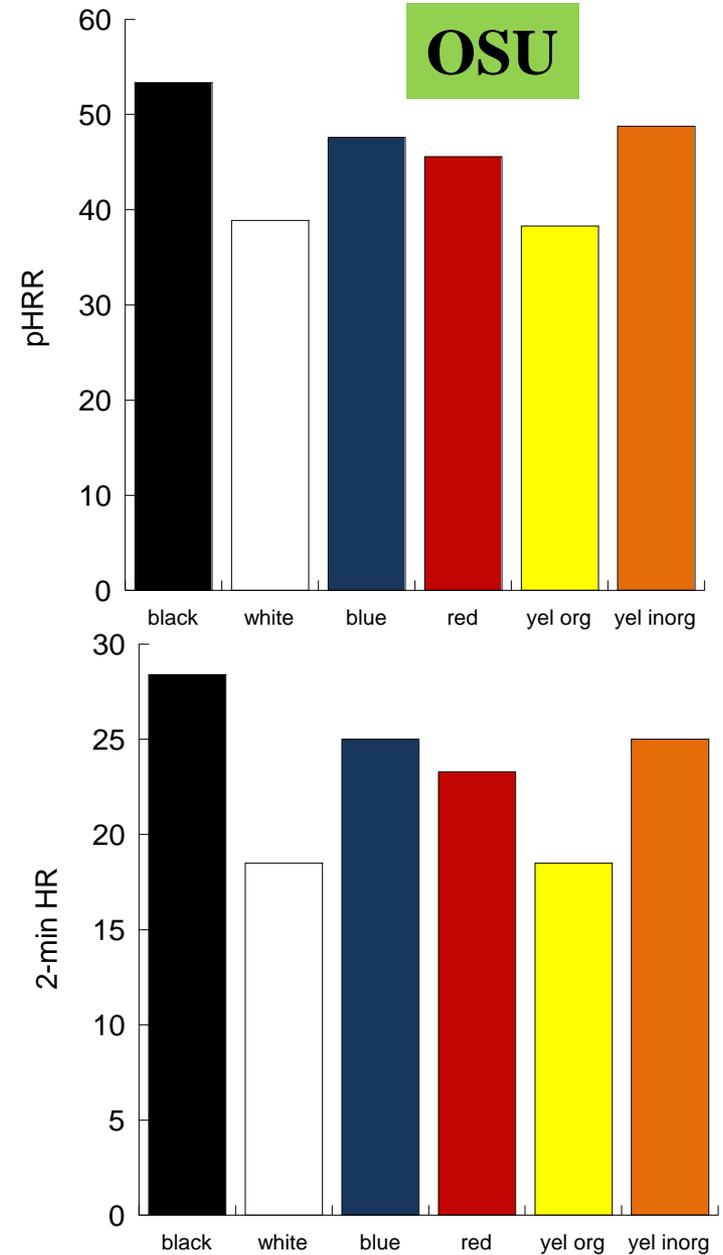
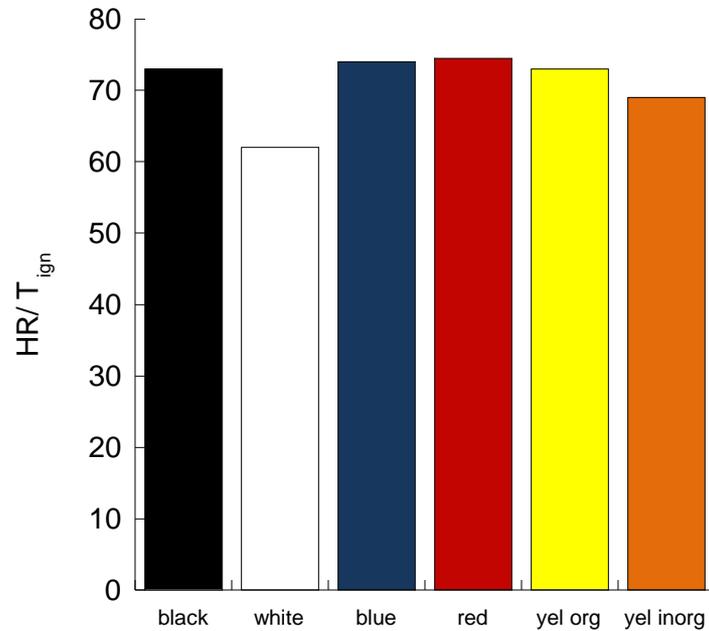
(Ref. Industry Standardization Task Group Report, 2012)

- 7 different colors (black, white, red, brown, blue, yellow, orange)
- 3 different suppliers
- OSU tests results (pHRR, HR and smoke density) are available
- MCC tests results available.
 - HR was measured
 - Data reanalyzed to obtain $T_{\text{ign}} = T_{20\text{W/g}}$

Paint samples from 2011 study:

Set C (HSN)

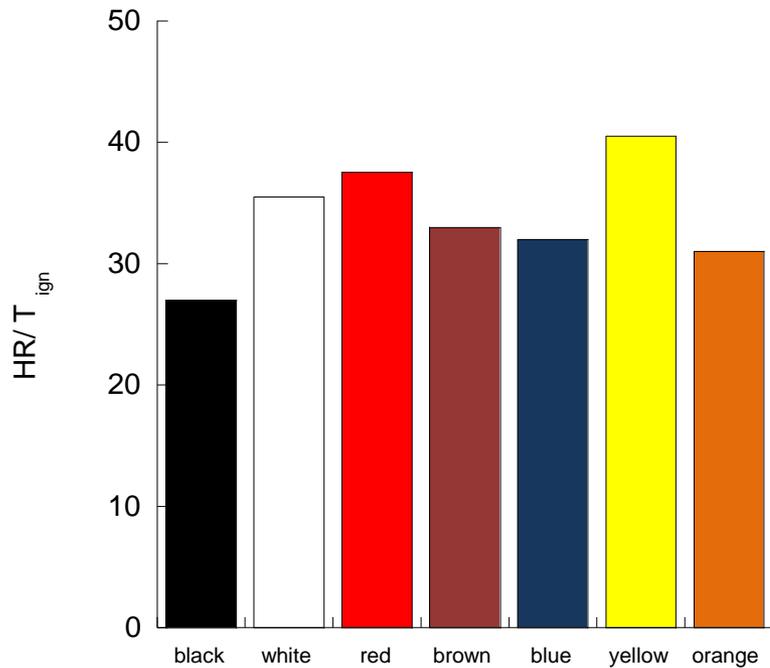
MCC



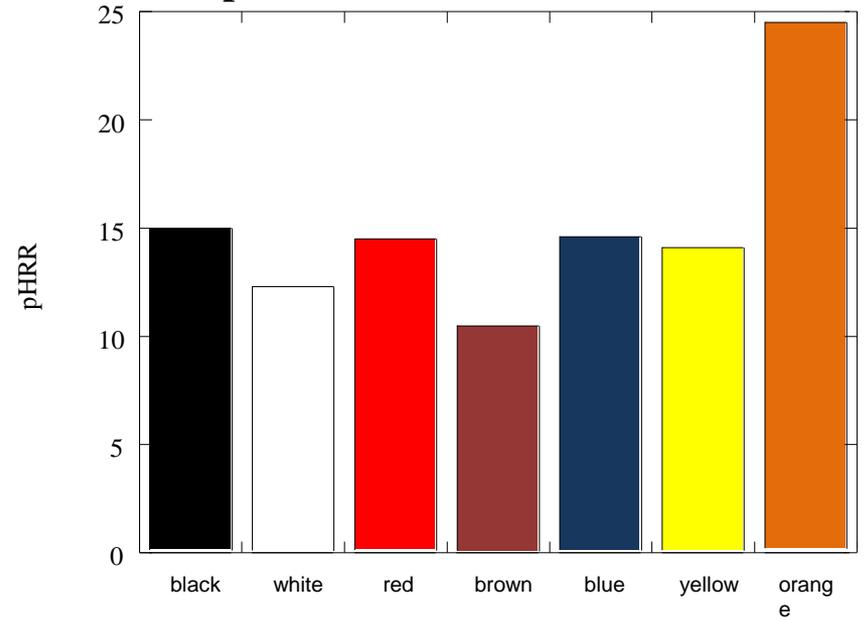
Paint samples from 2011 study

Set A (Mankiewicz)

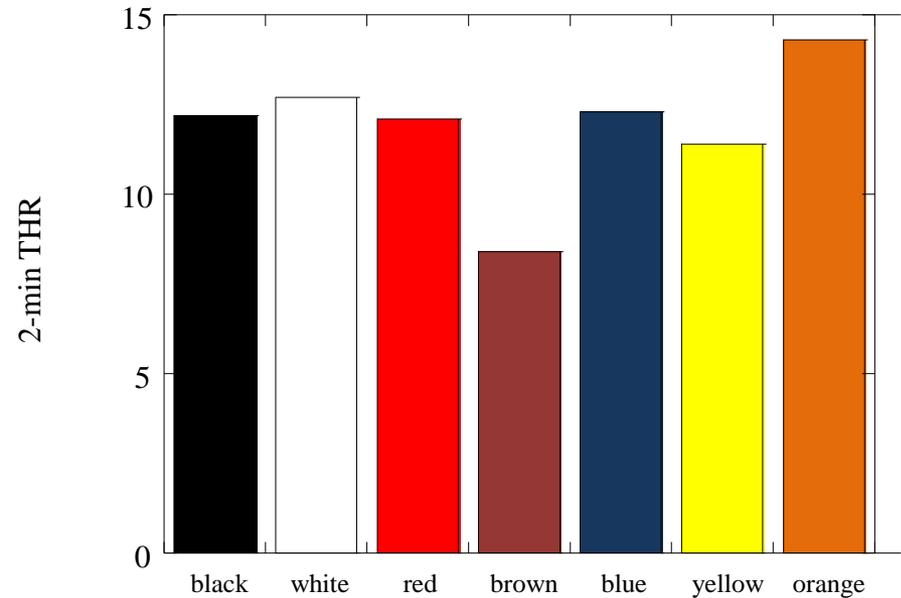
MCC HR/T_{ign}



pHRR for OSU

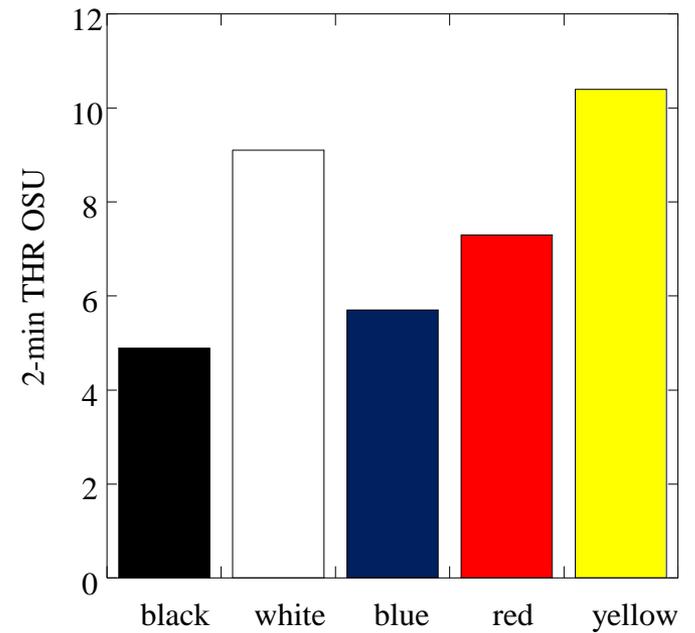
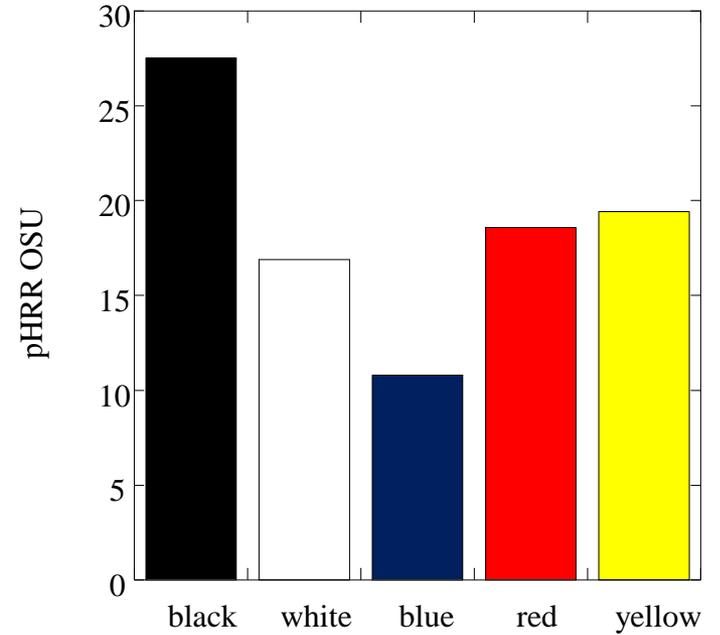
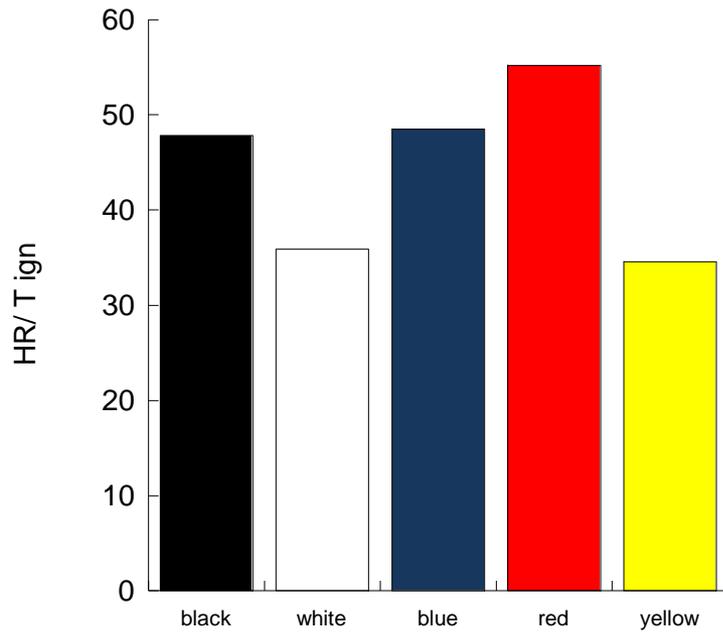


2-min THR



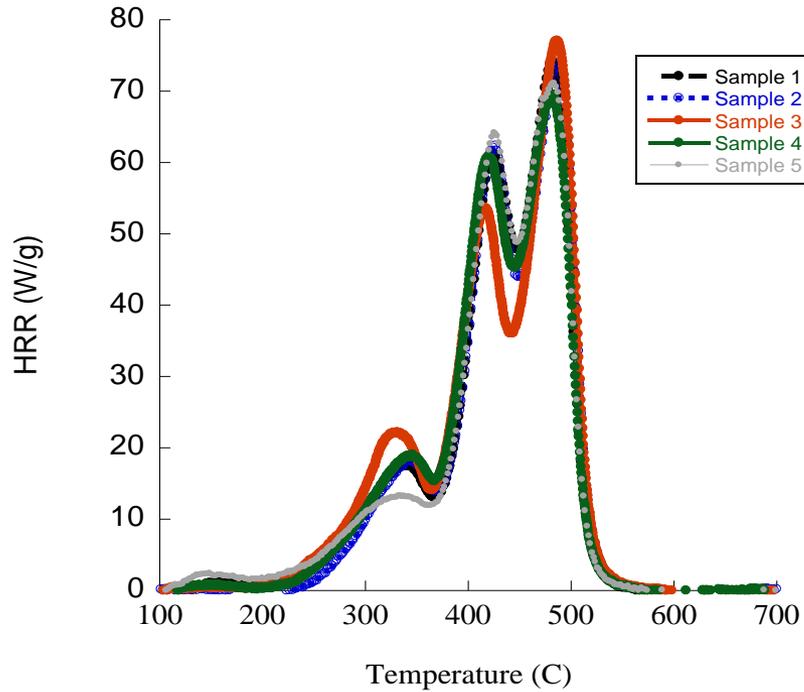
Paint samples from 2011 study

Set D (MapAero)



MCC test results on samples of white paint (2016)

Samples 1-5



Need OSU results for comparison

Sample	HRC sum	HRR _{peak}	HR	T _{peak}	T _{ign (int)}	T _{ign (20W/g)}	HR/T _{ign}
1	150	75	9.0	487	276	366	24
2	148	73	8.5	485	303	384	22
3	151	79	8.8	488	283	313	28
4	144	71	8.5	483	294	383	22
5	140	71	8.6	483	267	383	22

Proposed Next Steps:

- New round robin (including low flammability material like phenolic)
- Define standard methodology to define Tig
- Modification to ASTM standard to include Tig
- Definition of reproducibility limit for HR/Tig