CHEMISTRY THAT MATTERS™

OSU AND HR2 DATA COMPARISONS - THERMOPLASTICS

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TESTING AND FAA ACTIVITY TIMELINE

TECH CENTER ACTIVITY AND TESTING OF SABIC MATERIALS

With a **Thank You** to **Mike Burns** for the support:

- 2015 – LEXAN™ FST samples to FAA for equipment parameter round robin of HR2
- 1 HR2 test of LEXAN FST material…but “too messy” (potential time consuming clean out) for round robin
- IAMFTWG meetings: Understanding that thermoplastics will need to be tested before all is finalized
- Sept. 20, 2016 - LEXAN FST 9405, LEXAN FST9705, and ULTEM™ 9085 samples tested in OSU and HR2 side-by-side. OSU looked very good compared to SABIC’s historical third party data, but HR2 had generally higher results, with no consistent improvement in variability. Ranking of materials in **Peak HRR** changed (highest in OSU became lowest in HR2)
- Next day: Temperature measurements in burn chambers show HR2 chamber was hotter by app. 100 deg. F
- 2017 – modifications made to HR2 per IAMFTWG communications, 250 samples of ULTEM 9085 material sent to tech center. Aug. 30-31, ULTEM 9085 samples tested in HR2 and OSU (Mike Burns)
- October, 2017. Mike shares initial comparison data on ULTEM 9085 material, after HR2 modifications. Looks good. Data is limited. More and varied thermoplastics should be compared.

LEXAN™ 9405 MATERIAL – SEPT. 20, 2016 DATA

OSU Data

LEXAN 9405 material		White	
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	48.8	88	32.1
2	55.3	93	32.7
3	51.8	92	34.8
Mean	52.0	91.0	33.2
StDev	3.3	2.6	1.4
StDev as % of mean	6.3%	2.9%	4.3%

% HR2 is Higher Than OSU

Peak	Total
3.8%	17.9%

Standard Deviations also higher for HR2 Data

HR2 Data

LEXAN 9405 material		White	
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	62.9	90	41.6
2	52.4	110	40.8
3	46.6	92	35.0
Mean	54.0	97.3	39.1
StDev	8.3	11.0	3.6
StDev as % of mean	15.3%	11.3%	9.2%

LEXAN™ 9705 MATERIAL – SEPT. 20, 2016 DATA

OSU Data

LEXAN 9705 material		White	
Gauge	0.080 inch		
Sample	**Peak HRR**	**Time to Peak**	**2 Min Total**
1	44.1	198	13.3
2	37.5	213	15.3
3	42.9	130	22.3
Mean	41.5	180.3	17.0
StDev	3.5	44.2	4.7
StDev as % of mean	8.5%	24.5%	27.9%

% HR2 is Higher Than OSU

Peak	**Total**
69.8%	104.7%

HR2 Data

LEXAN 9705 material		White	
Gauge	0.080 inch		
Sample	**Peak HRR**	**Time to Peak**	**2 Min Total**
1	80.6	129	42.5
2	71.2	143	31.7
3	59.6	172	30.0
Mean	70.5	148.0	34.7
StDev	10.5	21.9	6.8
StDev as % of mean	14.9%	14.8%	19.5%

ULTEM™ 9085 MATERIAL – SEPT. 20, 2016 DATA

OSU Data

ULTEM 9085 material		White	
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	43.2	293	12.1
2	36.2	262	15.7
3	38.8	252	11.9
Mean	39.4	269.0	13.2
StDev	3.5	21.4	2.1
StDev as % of mean	9.0%	7.9%	16.2%

% HR2 is Higher Than OSU

Peak	Total
67.7%	39.3%

HR2 Data

ULTEM 9085 material		White	
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	58.6	237	18.1
2	64.7	273	18.9
3	74.9	299	18.3
Mean	66.1	269.7	18.4
StDev	8.2	31.1	0.4
StDev as % of mean	12.5%	11.5%	2.3%

ULTEM™ 9085 MATERIAL – AUG. 30-31, 2017 DATA – MIKE BURNS

OSU Data

ULTEM 9085 material			
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	39.6	254	29.6
2	55.4	265	24.7
3	48.6	262	26.8
Mean	47.9	260.3	27.0
StDev	7.9	5.7	2.5
StDev as % of mean	16.6%	2.2%	9.1%

% HR2 is Higher Than OSU

Peak	Total
6.5%	16.3%

HR2 Data

ULTEM 9085 material			
Gauge	0.080 inch		
Sample	Peak HRR	Time to Peak	2 Min Total
1	49.2	166	34.2
2	56.6	202	30.7
3	47.2	205	29.4
Mean	51.0	191.0	31.4
StDev	5.0	21.7	2.5
StDev as % of mean	9.7%	11.4%	7.9%

MORE MATERIAL DATA IS NEEDED

COMPARISON TESTING

Overall Objective: Ensure the HR2 test does not cause materials that currently pass** OSU 65/65 to fail new requirements, nor cause non-OSU 65/65 materials to pass. Compare forced-ranking of materials in each test.

Goal: Establish comparison data on a variety of current aircraft-grade materials that pass OSU 65/65 and do not pass OSU 65/65. Test a broad a range of reaction to fire properties in established aircraft products.

Possible reaction-to-fire properties for consideration:

- Higher and lower melting point thermoplastic materials
- Dripping and, if possible, non dripping thermoplastics
- Active vs. passive flame retardant properties
- Variety of base chemistries
- Intumescing char levels

** - If HR2 significantly reduces scatter/variability vs. OSU, one could reasonably expect some “borderline” materials to become consistently passing or failing. Any initial comparisons and forced-rankings should focus on materials with established pass/fail results in the OSU.

THERMOPLASTICS

SABIC MATERIALS

Material	Chemistry	OSU 65/65	Reaction-to-fire & notes
LEXAN™ 9705 material	PC co-polymer	Yes	Charring, intumescing, melting, dripping
LEXAN 9405 material	PC co-polymer	Yes	Charring, intumescing, melting, dripping. Higher flow than LEAN 9705 material.
ULTEM™ 9085 material	PEI	Yes	Charring, intumescing. Some melting, dripping. Higher heat than LEXAN resins.
An ULTEM AR series material	PEI and Glass	Yes	Expectation: Same as ULTEM 9085 material, but less dripping and lower numbers.
ULTEM 1000 material	PEI	No	60 second vertical grade. Charring and intumescing. Maybe more melting and dripping than ULTEM 9085 material.
LEXAN F6000 material	PC and flame retardant	No	60 second vertical grade. Some charring and intumescing. Melting and dripping.

OTHER PLASTICS

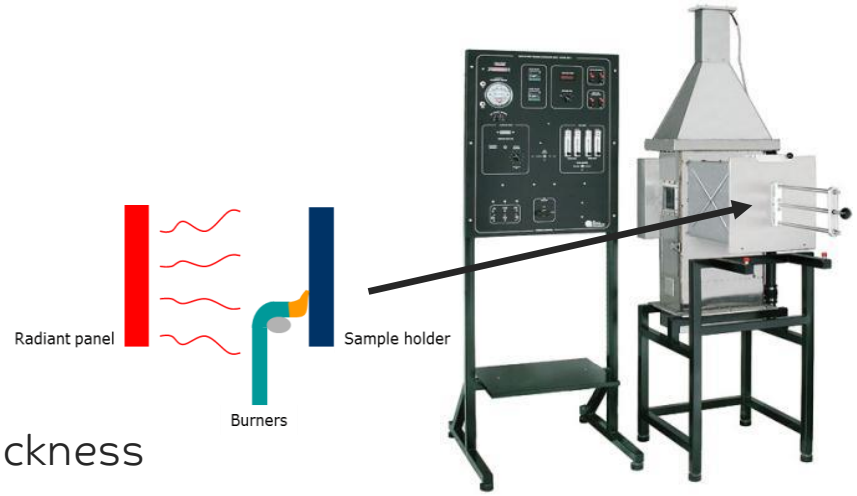
OTHER MATERIALS TO CONSIDER

Tradename	Chemistry	OSU 65/65?	Reaction-to-fire & notes
	PVC/Acrylic	Yes	Charring. Lower melting point material, but maybe not much dripping?
	PVC/Acrylic	No	?
	PEEK	Yes	?
	PEEK	No	?

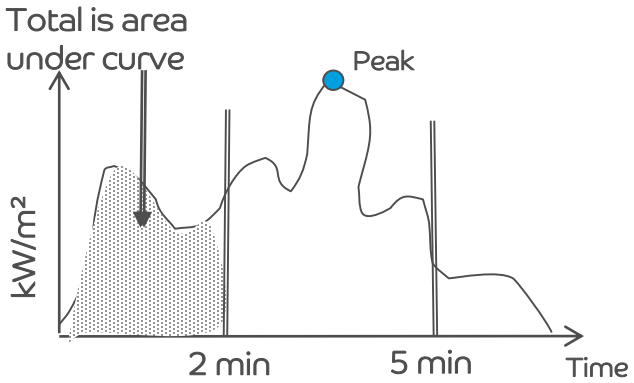
THE OSU TEST

HEAT RELEASE (OSU – OHIO STATE UNIVERSITY)

- Added in 1986
- FAR 25.853 & 25.855 App. F, Part IV
- Intent is to model a post-crash, fuel fed fire
- Goal is to extend time to cabin flash-over.



Test apparatus	OSU (Ohio State University) calorimeter
Specimen	3, size: 5.91 in. x 5.91 in. (150 mm x 150 mm) x actual thickness
Exposure	35 kW/m^2 plus pilot flames
Requirements	Average peak heat release during 5 min. tests ≤ 65 kW/m^2
	Average total heat released during the first 2 min. ≤ 65 kW-min/m^2



Why 65/65? These values correlated to the "good" materials tested in larger scale tests when test was being developed.


THANK YOU

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