VEHICLE INTERIOR AIR QUALITY
OICA TF REVIEW

2015-6-08

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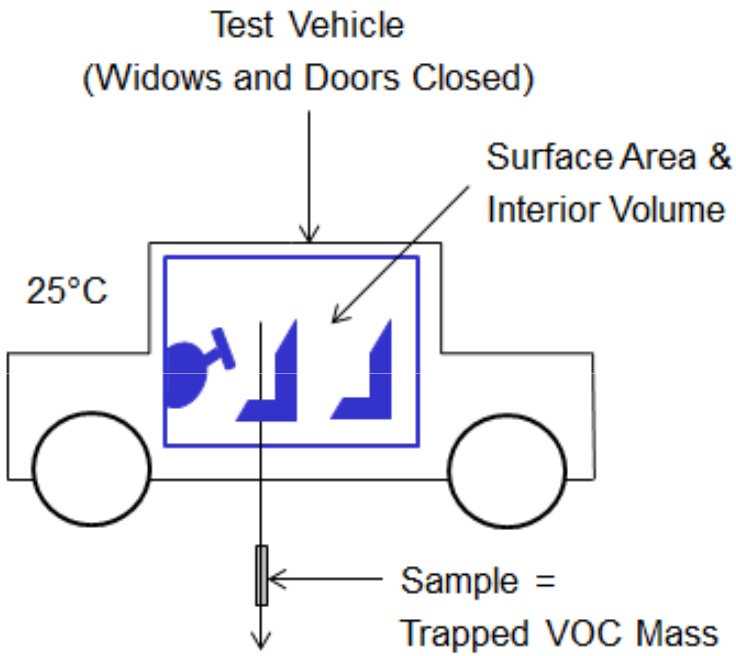
Vehicle Testing Calculations

Concentration is a function of (**Material Properties, Temperature, Soak Time, and Ventilation**)



Sample Volume =
Flow Rate * Sample Time

$$\boldsymbol{VOC\ Mass} = Concentration \cdot Flow\ Rate \cdot Sample\ Time \cdot conv.$$

$$\frac{VOC\ Mass}{VOC\ Volume}$$

$$\boldsymbol{VOC\ Mass} = \frac{\mu g}{m^3} \cdot \frac{L}{min} \cdot \min \cdot \frac{m^3}{L}$$

$$\boldsymbol{VOC\ Mass} = \frac{\mu g}{0.006\ or\ 0.025} \cdot 0.20\ or\ 0.83 \cdot 30 \cdot \frac{1}{1000}$$

The sample is on a thermal desorption tube analyzed by GC-MS to ISO-16000-6 or DNPH Cartridge to ISO -16000-3.

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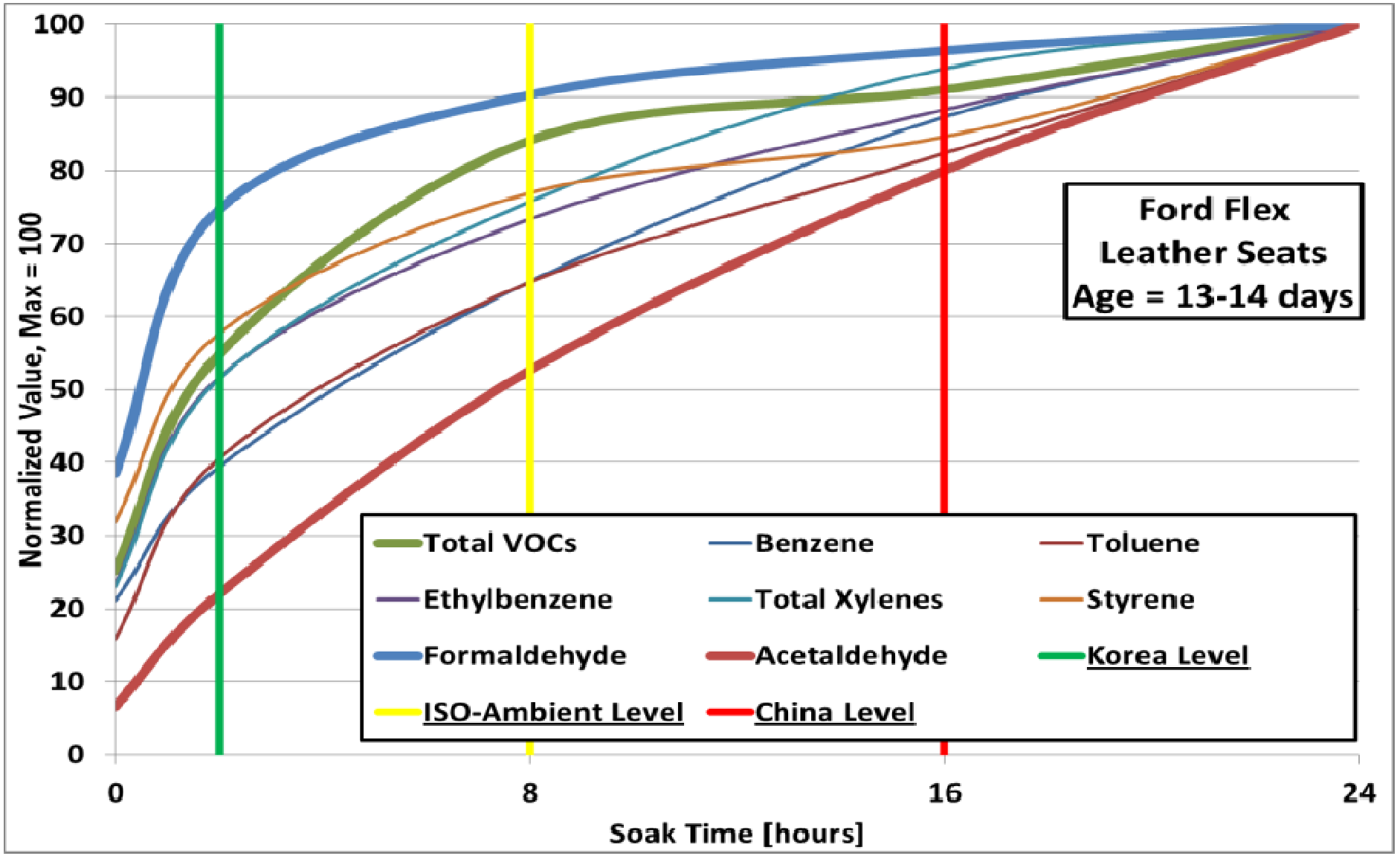
Vehicle Method and Time Study



Suggestions for Increased Measurement Accuracy

- Accuracy typically increases with an increase in mass on the samples.

- There are several method changes that we can discuss to increase mass on the samples without breakthough.
  - Higher sample flow rates, 50 mL/min vs. 200 mL/min
  - Longer sample times, 15 minutes vs. 30 minutes
  - Longer vehicle closed door soak times
    - Sample where the rate of change is lower.
    - Understand and consider laboratory test operations including a single 8 hour shift operation
  - Higher temperatures, 23C vs. 25C

- Special note - limit values should reflect method changes.

Vehicle Method and Time Study

- Two new vehicles were tested under different but typical conditions
  - Focus SE, windows open between tests = “daily use”
  - Focus ST, windows closed between tests = “dealership lot”
  - From day 4 to day 60
  - Korean, ISO, TUV and China Methods
  - Test method windows closed soak times
    - Korean = 2 hours
    - ISO Part 1 = 8 hours
    - China = 16 hours

- Next slides are VOC concentration [µg/m^3] plots for each compound or group of compounds
  - Each plot is normalized to the highest test value
  - Note: TVOC is not regulated and drops quickly over time with windows open but this not true for Formaldehyde and Acetaldehyde. Also keep in mind, China limits for Formaldehyde and Acetaldehyde are difficult to meet.

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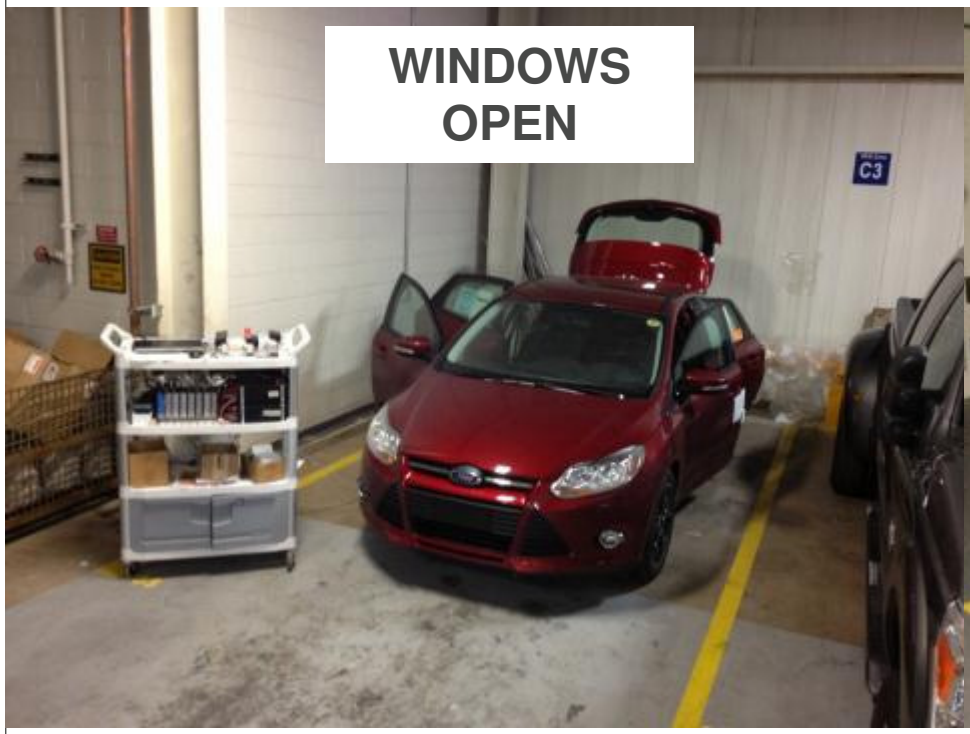
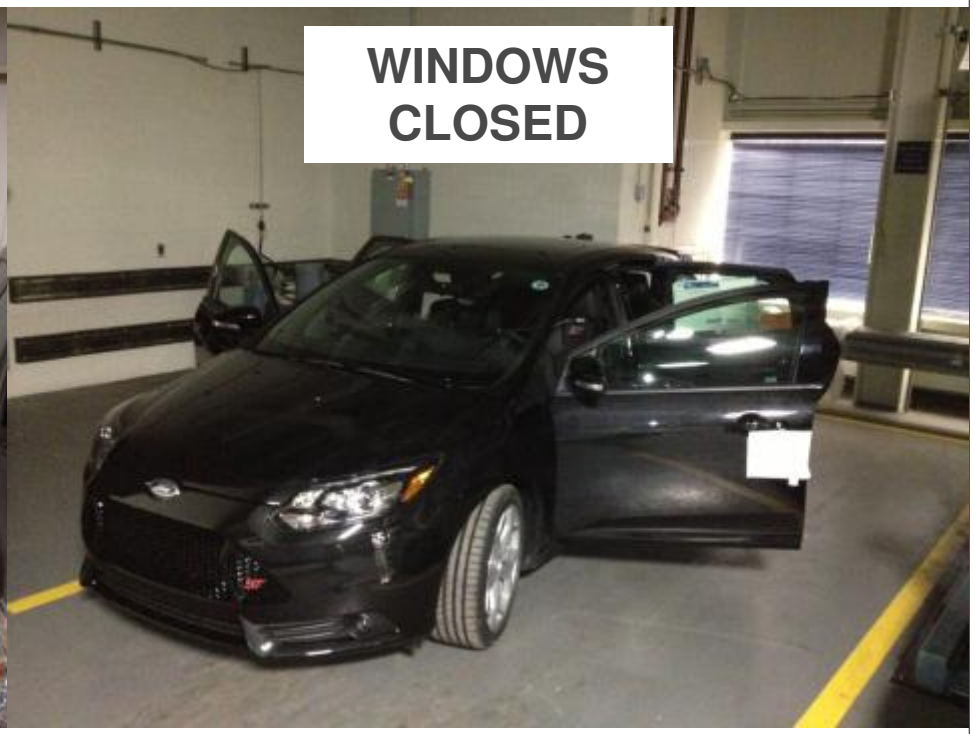
Vehicle Method and Time Study



SE with leather seats



ST with leather seats

Ran 20 tests in Ford's Allen Park Test Laboratory, 2nd and 3rd Floor Soak area

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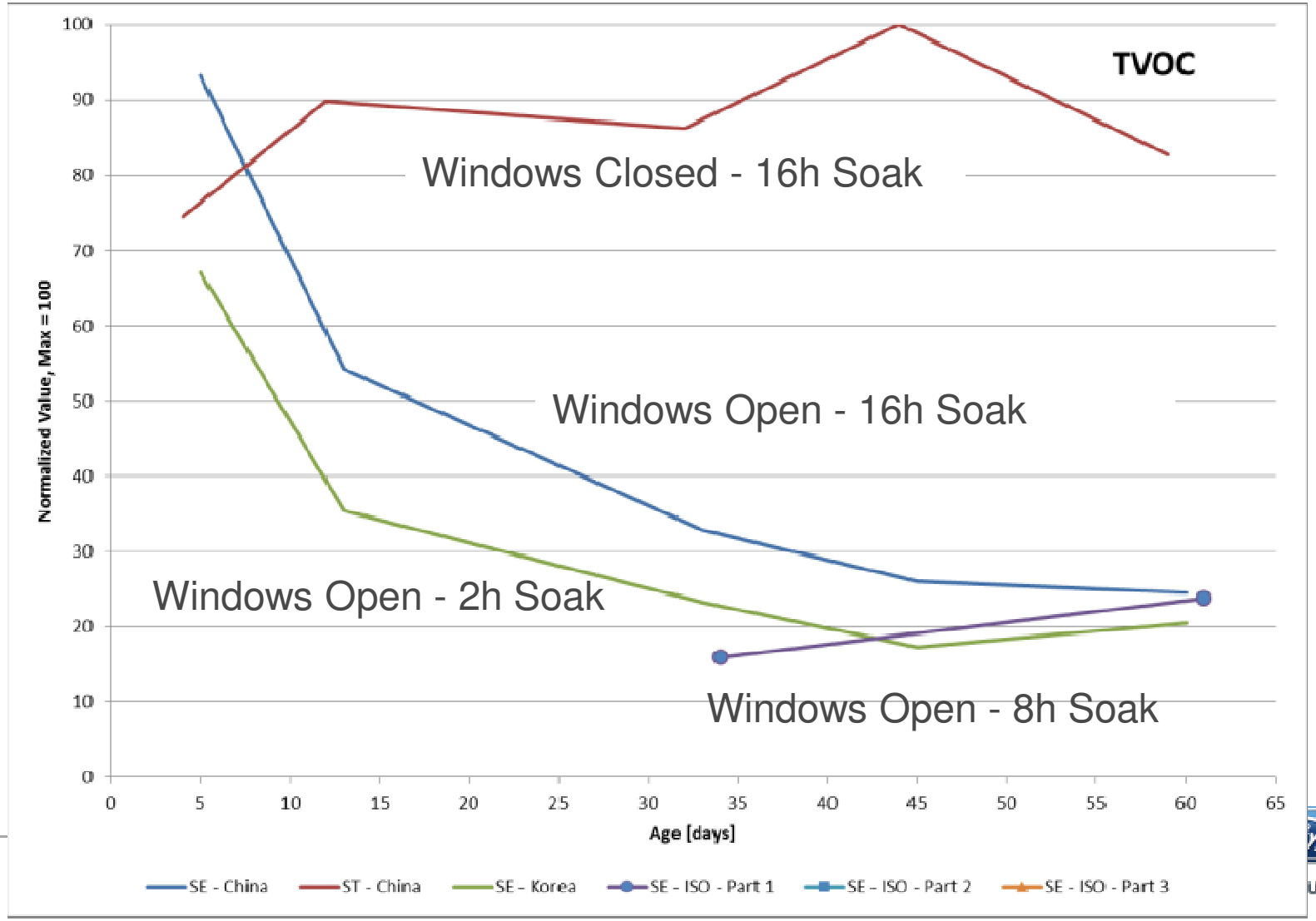
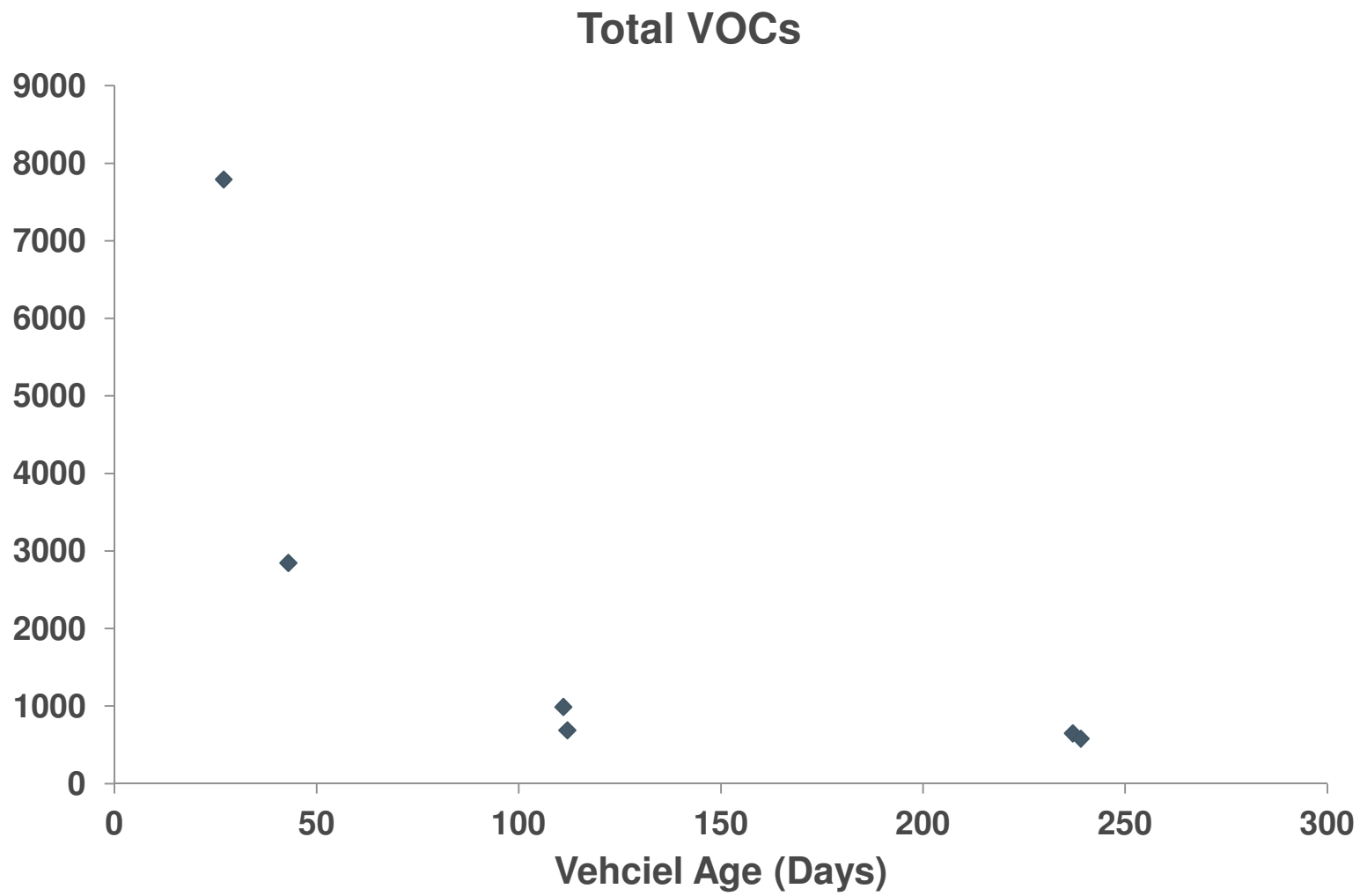
Vehicle Method and Time Study



Long Term Vehicle Testing - TUV Test Procedure



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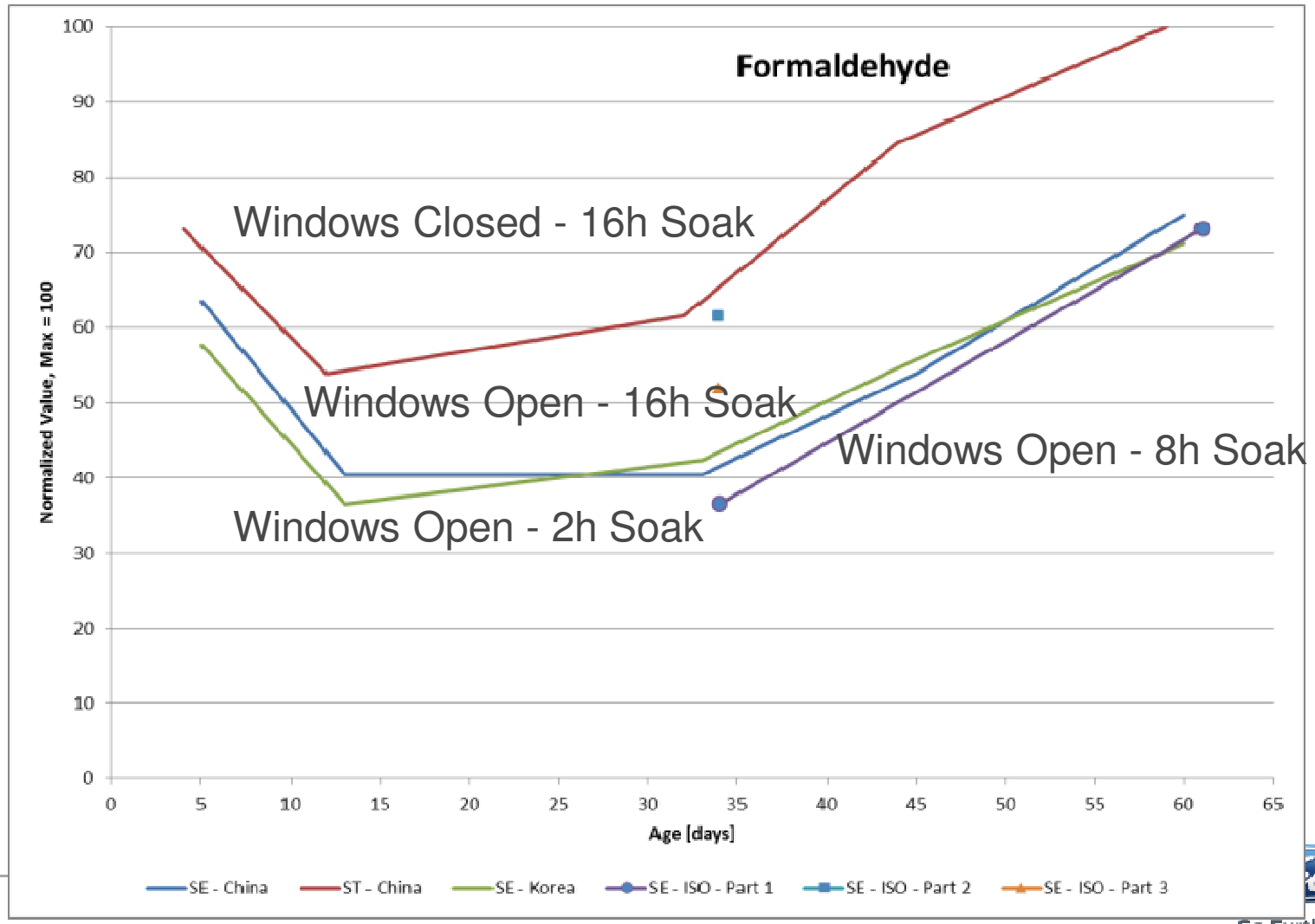
Vehicle Method and Time Study



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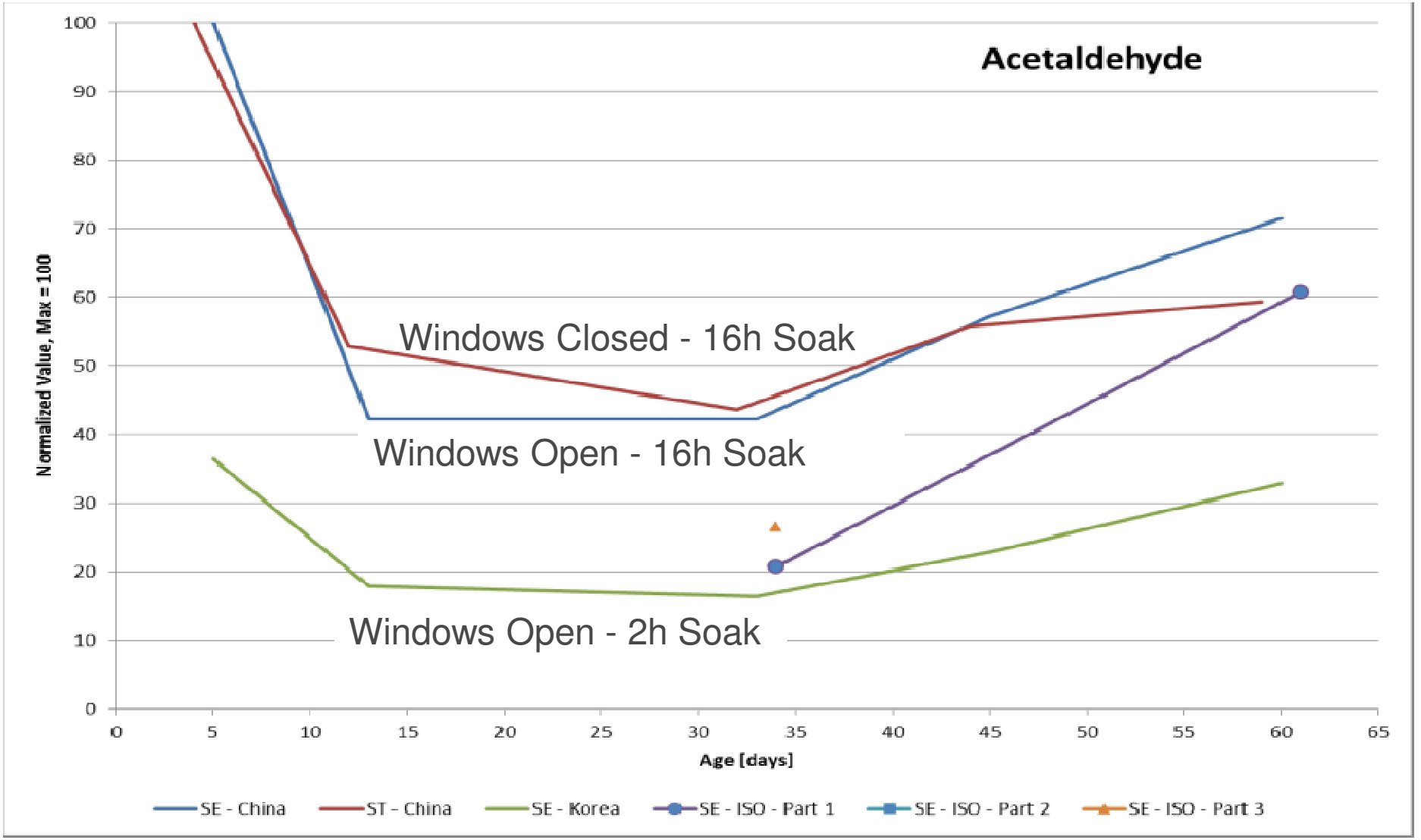
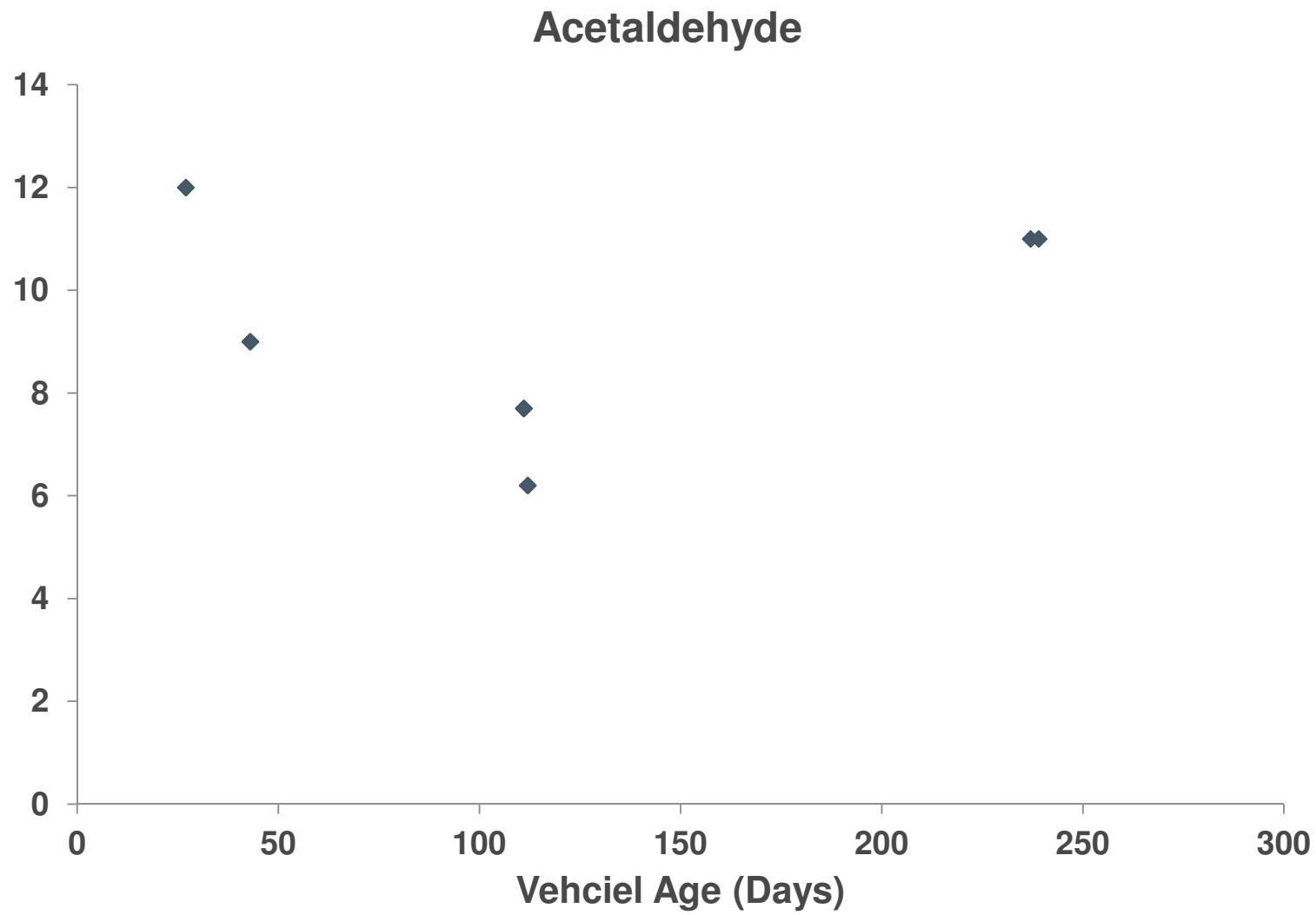
Vehicle Method and Time Study



Long Term Vehicle Testing - TUV Test Procedure



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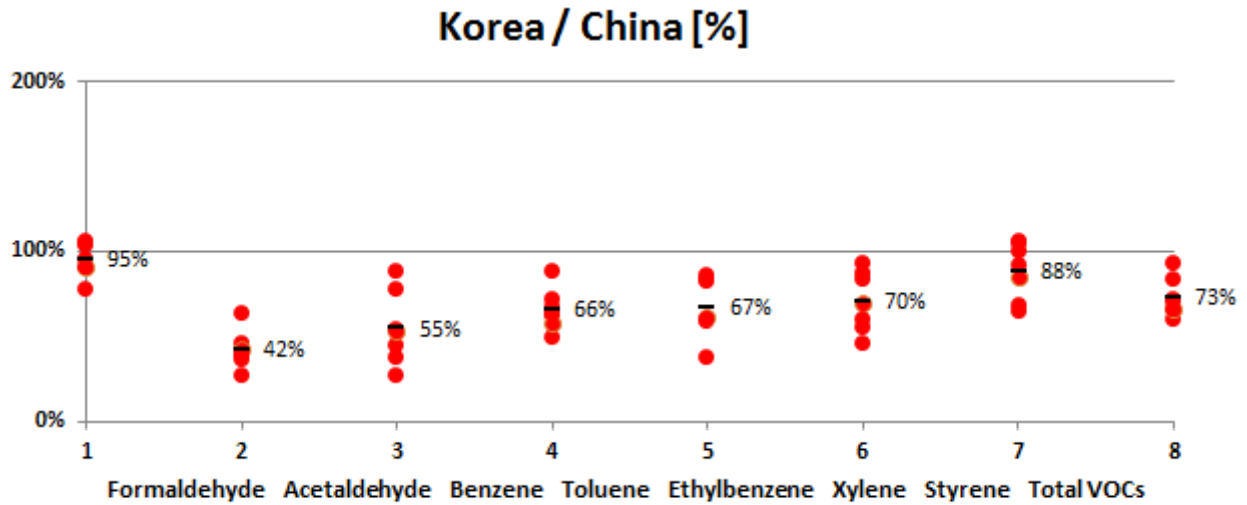
Global VIAQ Regulations: Method Correlation Factors



Method correlation by testing up to 16 different vehicles consecutively to the China, Korean, and three parts of the ISO test method.

Data shows correlation between the regional methods and the ISO method

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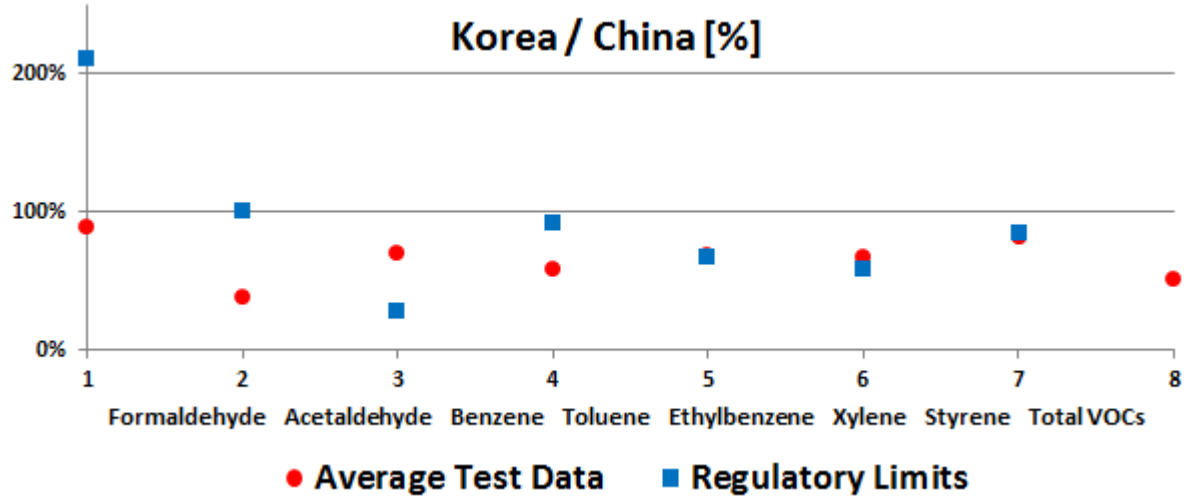
Global VIAQ Regulations: Method Correlation Factors



Regulatory Limits	Formaldehyde	Acetaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	Styrene	Total VOCs
Korean Limits	210	50	30	1000	1000	870	220	
China Limits	100	50	110	1100	1500	1500	260	

Korea vs. China								
Regulatory Limits	210%	100%	27%	91%	67%	58%	85%	
Average Test Data	88%	38%	70%	58%	68%	67%	81%	51%

The chart and tables shows the percent difference between either the national (Regulatory) limits and the national test methods. Note, for Formaldehyde the test method differences are nearly equivalent (100%) despite great difference in soak time, 2h vs.16h. But the limit values are not the same.

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Conclusions

- The full ISO test method, all three parts, should be discussed and adopted by the GRPE working group to achieve global harmonization.
  - Any modifications, if necessary, should be presented to ISO TC 146/SC 6/TC22 Joint WG 13 as improvements.
  - The next ISO JWG 13 meeting will be held in the week from 21 September to 25 September 2015 in Delft, the Netherlands.

- Vehicle material emissions can be characterized using the ISO ambient mode
  - Data shows good correlation between the regional methods and the ISO method's ambient mode.
  - The main issue of harmonize is the ambient mode soak time: 2, 8 or 16 hours.
    - Consider laboratory operations including an 8 hour operation with limited test site capacity.
    - Consider sampling when the emission rate is more stable.
    - Compound limit values should reflect method changes.
  - Improve to test repeatability
    - Increase mass on the sample; a function of soak length, sample flow rate, soak temperature
    - Include more quality control checks like duplicate samples and include void criteria.
  - Standardize test reports with defined data fields and data format

- Vehicles are not always under ambient conditions.
  - At elevated temperatures the concentrations will be higher
  - When driven vehicle concentrations will rapidly reduce due to ventilation

QUESTIONS

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