

Review of Oregon Department of Transportation Asphalt Mixture Density Requirements and Associated Pay Factors

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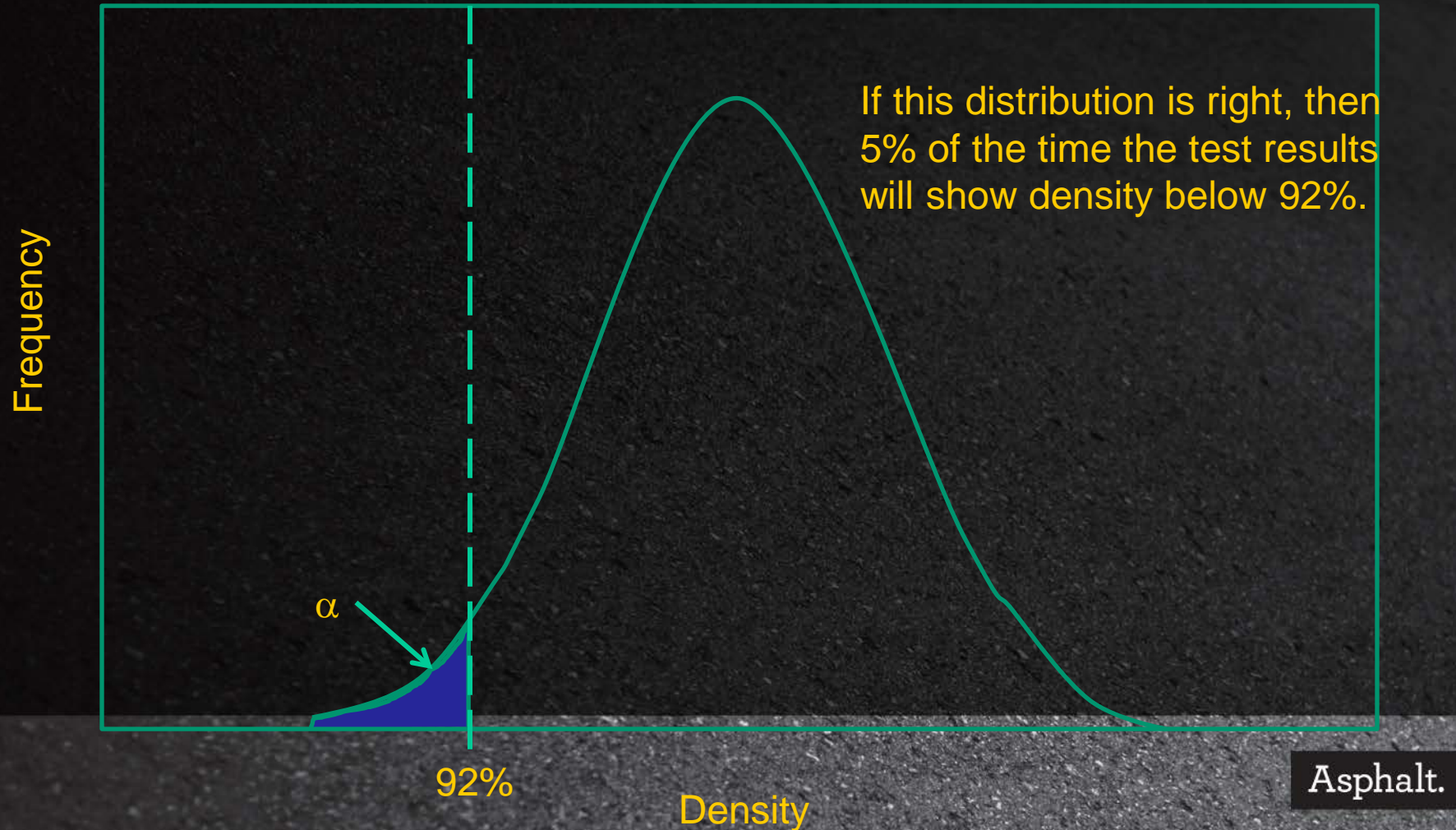
Stat Spec

- Statistical specifications are used to help us evaluate the acceptance of materials and processes that vary
- They allow us to account for variance not related to the Contractors materials and processes
- PWL is defined as the percentage of tests in a lot falling above the lower specification limit and beneath the upper specification limit.

PWL Specs

- Percent within limits specs allow a given percent of test results to fall below the lower spec limit
- For density (one sided) 95% within limits assumes up to 5% will be below the minimum
- Mean and Standard deviation along with the number of test results are used to determine PWL

For Whole Distribution



Why accept material below the spec limit?

- We use PWL to fairly account for variability outside the contractors control
- Up to 50% of the variance is often associated with sampling and testing
- Using Mikes data for variance of T209 and the Nuclear gauge in combination can yield +/- 0.5% compaction for just 1 standard deviation, at 2s you get +/- 1.1%

Variability

- So for a single operator, one gauge, combined with a single tester performing a rice gravity
- A “true mean” density of 92% can have a 2s variation of 90.9% to 93.1% just owing to testing variability

For Density

- A test result is the average of 5 random individual tests taken in the subplot
- So for 95% within limits 5 out of 100 sublots would be expected to be below the lower spec limit
- A test result below the lower spec limit is not (necessarily) non-specification

Why?

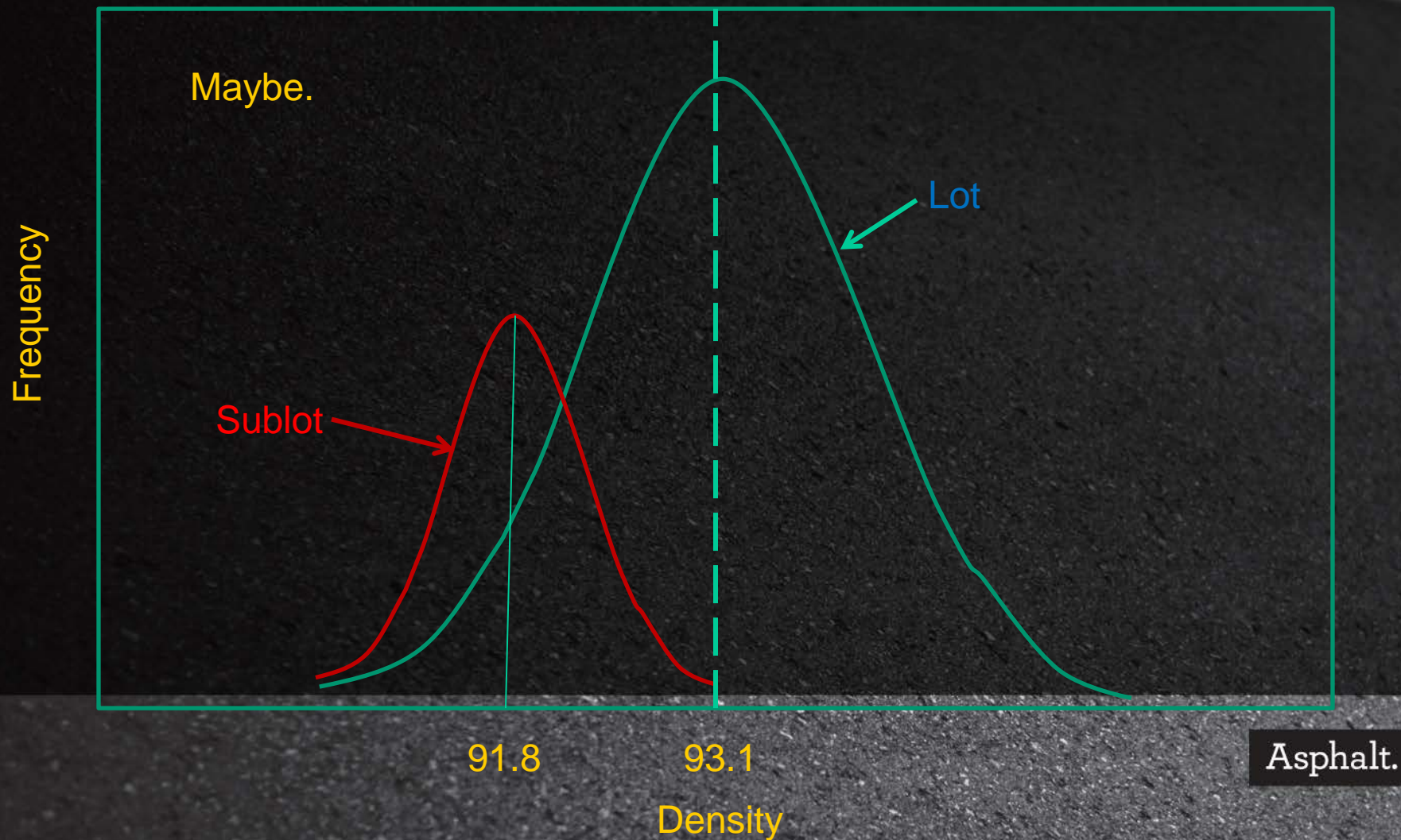
- 5 random tests are inadequate to define the true mean and the true standard deviation
- The 5 random test are not intended to define the true mean of the subplot,
- Their purpose is to provide 1 “test result” needed to estimate the true mean and standard deviation of the lot

PWL Specs

- Typical standard deviations for asphalt compaction based on individual test results are around 1.5%,
- For an average of 5 tests per subplot this equates to about 0.68%
- 95% within limits for density will have on average of 5 sublots below 92% out of 100 and will receive a pay factor of 1.03 with a mean of 93.1% and $s = 0.68\%$

Does Sublot Belong to Lot?

Separating this sublot out would not be appropriate if it is statistically part of the lot population



Required mean for 100 PWL and $s = 0.68$

Number of Sublots (n)	Quality Level	mean density for 100% within limits
5	1.79	93.2
10	2.65	93.8
20	3.2	94.3
50	3.54	94.4
100	3.7	94.5

The Problem

- Current spec defines any subplot with mean density $< 92\%$ as non-spec
- PM can choose to separate this subplot out for analysis
- Stat spec is not designed or capable of determining pay for this situation and can only give pay factors < 0.75 (remove and replace)
- There is currently no rational approach to evaluating sublots near or below lower limit

The Problem

- Sublots can (and should) be separated out when they are found not representative of the whole lot
- Being above or below the lower limit is not by itself adequate means to make that determination

So....

- The current spec as written is in direct conflict with the design and intent of stat spec
- Sublots should only be separated if they are not representative of the entire lot population
- That determination normally needs to be made by statistical analysis

Solution

- Contract with outside “expert” consultant to develop rational approach to identifying and evaluating sublots that statistically do not “fit” the Lot population
- TTI , nationally recognized experts in Jon Epps and Dave Newcomb, Knowledge of National trends and methods

Does Sublot Belong to Lot?

