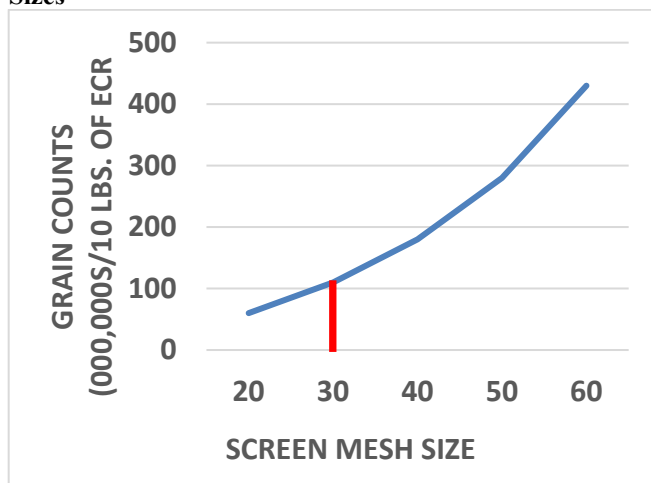


## SUPPLEMENTAL BINDER IN ECR MIX DESIGNS: TRANSFERRING ECR MIX DESIGNS FROM LAB TO FIELD

In the Asphalt Plus Technical Bulletin 2, ECR (Engineered Crumb Rubber) sample handling and mix design procedures are specified. As noted, the addition of crumb rubber to a mix design is the same as adding a very fine aggregate to a mix design. It creates more surface area requiring a binder film.

In the manufacturing process, ECR grain sizes are screened to meet an ASTM minus thirty mesh specification (ASTM D5644-01 30 MESH). This means that the ECR mean grain size is typically in the 50 mesh range (the average grain is approximately 1/50<sup>th</sup> of an inch, or 0.5 mm). With a 10 lb. ECR addition to a mix, approximately 110 million grains are added in a mix ton. ECR is typically less dense than standard aggregates used in asphalt mix design. Sand bulk densities can average around 100 lbs. per cubic foot, while ECR can average around 30 lbs. per cubic foot. Both the fine gradation and the lower bulk densities mean that ECR additions will add significant surface area to the aggregate already in the mix design.

### ECR Grain Counts with Variable Maximum Screen Sizes



Like other aggregate in the mix, ECR requires a film of binder in order to maximize beneficiation and to optimize the overall integrity of the mix. In the short period of time following the mixing of heated binder and aggregates/ECR, a portion of the binder film on the ECR will be absorbed into the surface pores of the rubber as long as the mix is heated up above 270 F (135 C). The interaction time is a function of both the ECR grain size and the temperature of the mix (higher temperatures, faster interaction). That rubber absorption of binder will increase the size of the rubber grains as well as the mix resistance to crack propagation.

Studies of optimum binder film thickness in asphalt mix design (NCAT Report 96-01) suggest that aggregate film thicknesses in the 6-8- micron range promote pavement longevity. When combined with the absorption of binder into crumb rubber surface pores, a 9-micron film thickness is used for the calculation of binder requirements caused by the addition of crumb rubber to an existing mix design. Given the set gradation of ECR, the supplemental binder required to generate a 9-micron film thickness is approximately 2 lbs. of supplemental binder (0.1% binder content addition) per 5 lbs. of added ECR.

This addition of supplemental binder is also covered in Technical Note 2 during the discussion of the mix design process with ECR. ***It is important to note that ECR additions in the lab should be included in the JMF used during production. Supplemental binder is a key element of the production mix design. A failure to include the appropriate supplemental binder content in the JMF can result in a drier mix that does not compact properly and is more prone to cracking.***