# Review of: "Effective use of Waste Materials: A Case Study of Utilization of Fly Ash in Flexible Pavement Structures"

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Potential competing interests: No potential competing interests to declare.

As noted in the contributions of the authors of this document, it is true that the results of numerous previous studies on the application of fly ash and other materials in asphalt and other road construction have resulted in practical applications.

The application of fly ash to asphalt can be summarized as follows:

First, asphalt filler is a fine powdered material used in asphalt mixtures. Primarily, stone powder made from crushed limestone is used, but blast furnace slag fine powder and fly ash are also sometimes used.

The roles of fillers are as follows:

1. to fill the voids in the aggregate and improve the stability of the asphalt mixture
Fillers improve the stability of asphalt mixtures by working in unison with the asphalt to fill the aggregate voids. This provides the following benefits:
Improved durability: Resistance to cracking, abrasion, and other forms of deterioration.
Improved water stability: Resistance to erosion from rainwater.
Improved workability: The mixture is more firmly entangled with each other, making it easier to install.

2. increase the apparent viscosity of asphalt
Fillers, when mixed with asphalt, increase the apparent viscosity of the asphalt. This has the following effects:
Improved fluidity: The mixture flows more easily into the formwork.
Improved stability: Settlement and fluidity of the mixture after construction is controlled.

3. other applications
Fillers are also used for the following applications.
Unevenness adjustment: Used to adjust the unevenness of the road surface.
Jointing: Used to fill in joints in road surfaces.
Paint undercoating: Used to improve paint adhesion.
Types of Fillers
Fillers can be classified into the following types:
Stone powder: Crushed limestone is the most commonly used filler.

Blast furnace slag fine powder: Crushed blast furnace slag, which is harder and more durable than stone powder.
Fly ash: Crushed ash from coal-fired power plants; lighter than stone powder and easier to work with.

Filler usage
The amount of filler used depends on the type and purpose of the asphalt mixture, but generally it is 5-10% of the total weight of the asphalt mixture.

Cautions on the Use of Fillers
The following points should be considered when using fillers:
Type of filler: The type of filler should be selected to match the asphalt mixture to be used and its intended purpose.
Amount of filler used: Too much filler can increase the hardness of the asphalt mixture, making it difficult to apply and prone to cracking.
Filler quality: Fillers must meet certain quality requirements.

To further summarize, fly ash can be used as a mineral filler in hot mix asphalt (HMA) pavements to improve pavement stiffness, durability, and rut resistance.
Fly ash is a byproduct of coal combustion at power plants, so it is essentially exhaust gas particles from the furnace that are captured and reused.

**(NOTE) The author contradicts himself by stating in the Introduction that "This composition makes fly ash non-reactive," but later accepts Seyrec's claim that "it has rapid hydration properties.**

When used as a mineral filler, fly ash must be dry and is usually handled in the same manner as hydrated lime. It is transported by pneumatic tanker to the HMA plant, stored in watertight silos, and weighed into the HMA using an auger. The optimum replacement rate depends on the type and chemical composition of the fly ash and its properties and affinity for asphalt. For example, lignite or subbituminous fly ash contains up to 30% more calcium than anthracite or bituminous fly ash, which contains only 4-6% calcium. The use of high-calcium fly ash has the potential to improve asphalt stripping in many aggregates.
When combined with bitumen, fine-grained fly ash increases the viscosity of the asphalt, resulting in a higher elastic modulus of the asphalt/fly ash concrete mixture. Coarse-grained fly ash, due to its larger particle size, creates more voids in the mixture, resulting in lower hardness than the other two mixtures.

These are the facts, but what has resulted from the great work of the authors is quite simple: broadly, the following assertions are made.
They would develop guidelines similar to those already developed by the FHWA, although they do not know what they are complaining about,
Or to establish a very vague method of analyzing road structures containing fly ash at the micro, macro, or mesoscale, which is not known,
Furthermore, field tests of asphalt concrete using fly ash in practice are needed, as well as guidelines for the use of fly ash in different applications, authors mentioned.

Like the above, at the end of the article, the author makes a few conjectural statements whose purpose and rationale are completely unclear.
In order for these assertions to be valid, it is necessary for a review paper to explain the necessity and purpose of these assertions with evidence.

It is highly doubtful that this can be called a systematic review.