

SECTION 97- BITUMINOUS SAND MIXES

General

2228. Sand or sand-gravel is mixed with between 4 and 9 per cent of bitumen or tar binder. This provides a very good waterproof carpet which can be laid in a single operation. Bituminous sand mixes have little inherent strength, and a good sub grade or base is essential.

2229. The thickness of construction may vary from 3 to 6 ins. A 4-in compacted thickness is normal: for any greater thickness two separate courses should be laid.

2230. A well laid mix will carry a high intensity of normal military traffic, provided that:

- a. Steel-tired vehicles are not allowed on it.
- b. Traffic intensity is limited to 1,000 vehicles per day for the first month.
- c. Continual starting, stopping, and maneuvering of heavy vehicles is prevented.
- d. The surface is properly maintained.

Tracked vehicles causes appreciable damage only when turning.

2231. There are three methods of construction: -

- a. Dry sand process (hot binder) (Bits and)
- b. Dry sand process (cold bitumen emulsion)
- c. Wet sand process.

Materials

2232. Grading of aggregate: - Suitable grading are given in Table 22.16.

2233. Binders: - Binders recommended for use with each process are given in Table

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**TABLE 22.16- GRADINGS OF SAND AND SAND-GRAVEL FOR
BITUMINOUS SAND MIXES**

Serial No	Aggregate grading (sieve size to BS 410)	Percentage Dassing	
		Sand-gravel mix	Sand mix
(a)	(b)	(c)	(d)
1	I-in	100	
2	No-7	65-80	100
3	No-25	50-65	70-90
4	No-100	15-30	25-43
5	No-200	5-10	10-20

TABLE 22.17 -BITUMINOUS SAND MIXES-RECOMMENDED BINDERS

Serial No	Type and grade of binder recommended
(a)	(b)
1	Dry sand process (hot binder) (i)- Temperate climates- Cut. back RC, Grade No, 1 or 2 (2 to 12 seconds at 25 ⁰ C) or
2	Cut. back MC, Grade No, 3 (25 to 30 seconds at 25 ⁰ C)
3	"Hot sand" areas eg. Middle East- Cut. back MC, Grade No, 4 or 5 (up to 150 to 300 seconds at 25 ⁰ C)
4	Dry sand process (cold binder)- Stable emulsion (ii)
5	Wet sand process (iii)- SRO whenever available (iv) or
6	Cut back, 20 to 50 seconds at 25 ⁰ C (v) or
7	Road tar, Type B, 20 to 50 seconds at 30 ⁰ C (iv)

Notes :-

- (i) Viscosity at mixing temperature should be low enough to ensure thorough mixing. if visccsity is too high, the material will tend to

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ball, Sand temperature also affects requirements and trials must be carried.

- (ii) Emulsion must be diluted with water (about 50 per cent subject to trial) to retard breaking. This process can only be used in areas where the moistened mix will dry out reasonably quickly.
- (iii) 2 to 3 per cent by weight of hydrated lime is normally mixed with the sand to improve mixing.
- (iv) No coating agents required. Temperature of application 150 to 200°F.
- (v) 10 per cent creosote oil and 2 per cent Adbevia T or CP³ should be added.
- (vi) 2 per cent Adbevia T or CPB should be added.

2234. Proportion: - The proportion of binder required to give the best results can only be determined by trial. The following may be used as a guide: -

- a. Dry sand process (hot binder) - The minimum has been found to be 12 gallons per cu yd of sand. If, at this rate, the mixture is too "fat" the proportion of binder should be kept constant but additional fines should be added to the aggregate.
- b. Dry sand process (cold binder)- For each 3 ins of compacted thickness, the rate is about 1 to 1 ½ gallons of emulsion per sq yd, in three separate applications.
- c. Wet sand process-As a basis for trials the following may be used: -

- (i) Cut-back, 4 to 6 per cent by weight of sand(dried).
- (ii) Tar, 7 to 9 per cent by weight of sand (dried).
- (iii) SRO. Sand (wet) 100 parts
 - Hydrated lime 2 „
 - SRO 5 „

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Dry sand process (Bits and)

2235. Mixing- In all cases, first remove unsuitable top soil, plate it clear of the road edges, and grade the formation to correct level, after mixing spread and compact as soon as possible.

a. Mix-in-place- For large scale work suitable plant items include graders, disc harrows, and a mechanical sprayer.

- (i) Scarify the working surface (harrows).
- (ii) Spread any material required to improve grading and mix in thoroughly with harrows ploughs, or rotary cultivators.
- (iii) Spray on binder, usually in three separate applications. Mix thoroughly with harrows (about 6 runs) or by balding with a grader, between applications.

b. Travelling Mixers. - Self- propelled machines pick up sand from a window, mix it with heated binder, and deliver the mixture either into a window, or direct to a spreading machine.

- (i) Form sand into one or more windows along the formation.
- (ii) Add any material required to improve grading and spread lime over the windrows as required.
- (iii) pass the machine over the formation at 6 to 8 ft per min, so that all material passes into the machine.

c. Stationary plant: - Ordinary concrete mixers are unsuitable paddle type mixers (single of double) are required. site the mixers and the bitumen heating plant at a convenient central point, to which all materials must be taken, after mixing, transport the prepared material the working site.

d. Hand mixing: - Results are problematical, but prospects of success are improved by using a more fluid grade of binder than in plant mixing, and by preheating the sand, eg, on CGI sheets over brushwood fires:-

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- (i) Excavate sand to the required depth and stack in alongside the formation.
- (ii) Measure each batch by gauge box and dump it on a mixing platform (Blanker).
- (iii) Max each batch thoroughly with shovels and rakes while adding gradually the correct quantity of binder.

2236. Spreading: - When spreading, allow for compaction.

a. Mechanical spreading: -

- (i) Spreading and finishing machines partially compact the material. they are usually fed by a travelling mixer, but can be supplied by tipping trucks.
- (ii) Graders give excellent results if skillfully operated.
- (iii) Spreader boxes provide the simplest method. A bottomless box, with the rear end raised to form a screed, is kept filled as it is towed along the formation, leaving a layer of material of the desired thickness

b. Hand spreading: -

- (i) Dump mixed material on dump plates.
- (ii) Spread as soon as possible, using shovels and rakes, heated if necessary. Men should work on planks to avoid making indentations.
- (iii) Use a timber screed for finishing.

2237. Compaction: - Lateral support is essential to retain the material on the formation, solid wheeled rollers must not be used in the early stages of compaction of a sand mix.

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- a. Initial compaction: - Except when using a spreading and finishing machine, use smooth track tractors or iron hand tampers. the latter should be wielded in unison by transverse line of 6 to 8 men.
- b. Second stage: - Pneumatic-tired rollers are best, but tire pressure should not exceed 100 lb per sq in.
- c. Final stage: - A solid wheeled roller is required. the time when it can be put to work depends upon its type and weight.

2238. **Maintenance:** - Until compaction by traffic is completed a gang of one NCO and 10 men should be allotted for the daily maintenance of each $\frac{1}{2}$ -mile stretch of road.

- a. Initial maintenance consists of dragging with a road drag and continuance of rolling to remove wheel marks and eliminates high spots.
- b. The edges of the carpet must be preserved. Spreading is best prevented by kerbs or well-packed sand.
- c. Depressions must be made good.
- d. Surface dressing is advisable when traffic compaction is complete. use high viscosity binder at the rate of one gallon to 4 or 6 sq yds, applied with rubber squeegees if available, Blend with sand of the same type as in the bits and mix.

Dry sand process (cold bitumen emulsion)

2239. In general, the method of construction is similar to the mix-in-place method with good binder (see Para 448 (a).) Quick breaking emulsions are unsuitable, as they break immediately on contact with the sand. stable emulsion is used, and it must be further diluted to retard breaking and to ensure even coating of particles and easy mixing, About 50 percent additional water is usually needed. fresh water is preferable, but sea water can be used.

2240. Mixing and spraying: -

- a. Loosen and prepare the sand, but do not moisten it before applying emulsion.
- b. Spray diluted emulsion on the surface in three separate applications, making a total of 1 to 1 ½ gallons per sq yd for each 3 ins of compacted thickness.
- c. Mixing must be continuous and should be done quickly.
- d. Complete by smoothing the surface with a grader, or with rakes, the appearance of water on the surface at this stage indicates that the emulsion is breaking.

Wet sand process

2241. General: - This process is satisfactory only when the material is laid on a sound base such as well compacted gravel. Procedure is similar to the dry sand process (hot binder), but the mix-in-place method and hand mixing are not applicable.

2242. Materials: -

- a. Sand: - Sand must be free from organic matter and should not contain more than 5 percent of clay or loam, Sand from the seashore can be used, variation in moisture content does not affect quality if a minimum of per cent of moisture is present.
- b. Binder and reagents: - see table 22.17.
- c. Proportions: - See Para 521 (c).

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2243. Mixing: - A vigorous mixing action is essential. For large scale work travelling mixers are ideal (see Para 522 (b)). For stationary plant mixing, the double paddle type of mixer is the most satisfactory. the wet sand and hydrated lime are put into the mixer first, and heated binder is then added by means of circulating pump from the bitumen heater. Mixing should continue until sand particles are thoroughly coated (usually about 2 to 4 minutes).