THE CHARACTERISTIC TRANQUILITY OF MUDBANKS, A CLUE TO FORM THEM ARTIFICIALLY-A HYPOTHESIS

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ABSTRACT

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The natural formation of mudbanks (Chagaras) at certain locations along the Kerala coast during the southwest monsoon is a well known phenomenon, An insight into the scientific reasons of the varying tranquility of a spectrum of mudbanks gives a clue as to how to form them artificially. The clue, born of experience in the fields is described here. With appropriate engineering design of devices the hypothesis may prove to be a useful proposition serving the cause of coastal fishermen who make their living by operating canoes for fishing from the neritic waters

General features

Mudbanks are calm stretches of muddy sea water widened from coast by a few kilometers (4-5 km) into the sea and occupying a length by a few more kilometers along the coast. The formation of mudbanks is associated with the southwest monsoon. As the name itself indicates., mud is required for the formation of mudbanks and in the coastal seawater the mud (sediment) is provided by the monsoons, either by churning the bottom mud into the neritic waters or by discharging the sediment from the mountains through the river mouths into the coastal sea water.

The mudbank waters are poorer in sun light penetration and dissolved oxygen content. Therefore, the primary production in mudbank waters is correspondingly poor. However, the nutrients. the standing crop of phytoplankton and secondary production are appreciably high in mudbank waters.

Locations

The best known mudbank of the southwest coast is the Alleppey mudbank. It occurs every year though it shifts its exact position from Alleppey in the north to Thrikkunnapuzha in the south (about 16 km). The other places along the Kerala coast where mudbanks were reported were Chellanam, Manasseri, Vypeen, Narakkal, Valappad, Nattika, Tanur. Parappanangadi, Beypore, Elathur, Quilandi, Muzhippilangadi, Adanur-N-Bella, Adakkathubail and Uppala in Kerala coast and Ullal in Karnataka coast. At majority of the places, the source of mud is either river discharge or coastal origin, at Vypeen it is the dredged mud while at Alleppey it is of subterranean origin (Silas, 1984).

Tranquility

The most impressive physical feature of mudbank is the perfect calmness of its area like a sheet of glass, while on all the three sides of its water boundary the waves are seen breaking with thunderous sound forming into a bee-line. This tranquility of mudbanks is availed by fishermen for safe launching and landing of their small fishing boats. With a dense grouping of canoes, with a thick population of fishermen in action and a good number of middlemen as buyers of catch, with headloads of baskets of fishes being carried from the canoes at nee-deep waters to the lorries on shore, it is an impressive sight at the mudbanks.

The reason for tranquility

The question arises as to how a particular spot along the coast is calm while waters along the entire coastline are muddy during the southwest monsoon. In other words, why the neritic waters of the non-mudbank regions along the coast are not free from wave action while they are also muddy.

In the case of wind-generated wave propagation, as long as the surface waves are in deep water, the velocity of the fluid particles decrease exponentially with depth from the surface. As they approach the shallow waters the velocity decreases hyperbolically with depth. As the waves are dammed, the fluid particle velocity decreases. Conversly, with the decrease of fluid particle velocity the wave damming occurs and calmness arises as a result of complete of cessation of waves (Newman, 1978). The mechanism required to reduce the fluid particle velocity is to increase the internal friction called viscosity of the fluid. The mud particles may be of three kinds. One is that which dissolved in seawater completely losing their physical identity. Such particles are called thexotropic particles. The salts dissolved in sea water and the thexotropic particles increase the viscosity of seawater. The second but more important category of solid particles are soles (microscopic) which increase tremendously the viscosity of the fluid without losing their physical identity. Based on hydro-dynamic principles, Albert Einstein derived that the viscosity of the fluid is increased by at least two and a half times to the volumetric concentration of the soles in the fluid.

$\mu_c = \mu_o (1 + 2.5\,\phi)$ where μ_o is viscosity of liquid medium before, soles are considerd, μ_c viscosity of solution after their entry and ϕ is the volumetric concentration of soles (Sheludko, 1966). Let us call them the Einstein particles.

The Third category of particles is gravity influenced bigger size particles the presence of which do not contribute to the viscosity of the fluid at all. But these particles avail the already existing viscosity of the fluid for their getting buoyanced in the fluid. These particles after certain downward travel with gravitational acceleration, overcome the gravity by their buoyancy and their further sinking is effected by unfiorm downward velocity which was called the terminal velocity by Stokes. The terminal velocity depends on the areal size of the particles and the density difference between the fluid particles and the solid particles. The terminal velocity decreases in a more viscous fluid. Let us call them the Stokes' particles whose presence in the liquid do not contribute to the viscosity of the fluid (Murty *et. al.*, 1984.)

In a muddy water if Stokes' particles are predominant and the first two groups of particles are negligible if not absent, then the water though muddy cannot bring damming effect on the waves. On the other hand, if the thexotrophic or Einstein particles are predominent in the muddy water, while the Stokes' particles are negligible, such muddiness reduces the wave height by its many fold increase of viscosity of the medium. As internal friction is increased by the increase of viscosity, the velocity of the flu id particles involved in the wave propagation gets reduced and hence the waves are dammed.

Therefore, what is needed for wave damming is increased proportion of Einstein particles and thexotropic particles in the mud when compared to Stockes' particles. Thus the contrast in mudbank and non-mudbank waters, though both look muddy alike, lies in the proportionality of the viscosity increasing and non-increasing solid particles in the mud. If the viscosity affecting solid particles get depleted from the mud-bank region by drift currents or tidal currents, the mudbank loses its quality of tranquility and it becomes short-lived.

Bottom currents also help in bringing calmness to the waters. Although the origin of propagation of wind-waves is sea surface but not the bottom, the bottom sediment can reduce the wave height, if the sediment is lifted into the water column above the bottom. Such a condition would arise, if bottom currents are present, Mud with high clay content containing more than 50% of weter is potentially unstable in the presence of even weak bottom currents. Moreover, the granular surface produced by burrowers makes the sediment water interface hydrodynamically "rough" which factor increases the probability of converting laminar into turbulent flow near the bottom. Large amount of sediments over watery mud bottoms are therefore re-suspended into the overlying water (Young,1971). Thus, the wave damming is improved by such bottom conditions,

ARTIFICIAL MUDBANKS

At some places, the coastline takes a small curve forming into a semi bay. If the current in the bay waters forms into single eddy and the bottom is extensively sedimentary in nature with sandy stretch of beach, such areas are suitable for selection to form artificial mudbanks. The centre of the eddy would be almost free of currents, like the eye of a cyclone.

On Selecting a suitable area close to the shore, sufficient amount of mud consisting the Einstein particles and the thexotropic particles mainly the former particles, has to be dumped at the eye of the eddy. The amount of mud getting mixed with water improves the viscosity of the aquatic medium at the eye region. By dumping more and more suitable quantities of quality mud along the periphery of the patch of the mud occupying the central position of the eddy, the bank can be enlarged to a reasonable extent. With such particles in good proportion in the water column, the breaker zone of waves recedes and finally the wave action gets limited to the seaward periphery and to the either side of the "bank" along the coast.

The simulated mudbank requires continuous monitoring with regard to the balance of its quality mud in its water column, as the littoral currents in its vicinity tend to erode the quality mud from it. Once the mudbank is established, it can be used for the canoes for their launching and landing purposes.

Once the mudbank sets in, the bacterial load at the bottom gets enhanced and the nutrient condition of the water column improves. The nutriently enriched calm waters of the mudbank provide ideal conditions for culturing suitable marine organisms. They also serve as launching pads of sea ranching of commercially important marine fishes in their seed stage.

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