

**BEACH MORPHODYNAMICS AND SEDIMENT  
CHARACTERISTICS AT SELECTED BEACHES  
ALONG TERENGGANU COASTAL REGION**

**NORAISYAH BINTI SAPON**

**Thesis Submitted in Fulfillment of the Requirement  
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## DEDICATION

*To*

*My loving parents,*

*My brothers and sisters,*

*My relatives,*

*&*

*My love one.*

*For their prayers, patience, devotion and untiring encouragement throughout the entire time  
spent in completing this thesis.*

*Thank you for your supports and motivations.*

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**BEACH MORPHODYNAMICS AND SEDIMENT CHARACTERISTICS AT SOME SELECTED BEACHES ALONG TERENGGANU COASTAL REGION**

**NORAI SYAH BINTI SAPON**

**December 2011**

**Chairperson : Associate Professor Rosnan Yaacob, Ph.D.**  
**Members : Associate Professor Khalid Samo, Ph.D.**  
**Nor Antonina Abbdullah, Ph.D.**  
**Institute : Institute of Oceanography and Environment**

Knowledge of coastal morphodynamic processes is necessary for complete understanding of the depositional or erosional framework of a coastline. The main aim of this study is to identify the processes that operate at the selected beaches along the monsoon coast of Terengganu in a year cycle. Beach profiles have been surveyed, and beach sediment samples were collected bi-monthly at each stations studied. During the Northeast Monsoon, the coastline is under the influence of strong waves and currents though during the rest of the year, it is subject to moderate and low hydraulic energy levels with relatively weak waves and currents.

Results indicate that the beach profiles show that they experience dynamic changes in a one year period of survey. During the Northeast Monsoon, most of the beach foreshores are eroded with overtopping processes shifting berm crests upward and landward. Sediments from the eroded foreshores are moved down into the water where longshore currents transport them in a downdrift direction to sites of accretion. During the rest of the year, accretion is dominant with the lack of high energy waves allowing swells to rebuild the beaches.

The beach sediments are exclusively sandy though they tend to increase in the very coarse and medium sand fractions during the Northeast Monsoon when higher energy waves and currents transport finer grained sediments down-drift, leaving behind the coarser fractions. The coarser beach sediments (-0.24 phi) during the Northeast Monsoon are also poorly sorted and negatively skewed in comparison with the relatively finer (1.69 phi), moderately well sorted and positively skewed sediments during the rest of the year. The interpretation of samples from distinct tidal levels suggests that the shore normal plain was subjected to various forces due to the distribution of processes acting on the portions of the beach.

The coarse grained sediments and high energy waves during the Northeast Monsoon also lead to steep foreshore slopes, though during the remainder of the year, lower energy waves and finer grained sediments result in less steep foreshores. The beach slope ranged between  $2.11^{\circ}$  –  $17.48^{\circ}$ . It could be noted that significant correlation obtained between the beach slope gradient and the grain-size properties. This strength relationship was clearly shown at the mid-tide tidal zone and thus, signifies that increasing of beach slope gradient resulted in increase of sediment size.

Statistical analysis of the grain size distributions of the adjacent estuarine sediments at the study area was also studied as it appears to be the main source of sediments to the beaches. The integration between beach and estuarine sediments indicates that sediment of beach near the estuary seems to be reflected in their characteristics. This signifies that the variability of sediments at the beach is certainly influenced by the forcing factors of its source that transport the sediment alongshore.

An attempt to classify the selected beaches of Terengganu in terms of its morphodynamic characteristics was successfully achieved even though some parameters had its limitation applicability. However, it could be generally define that the beaches along the Terengganu coastal region are classified as intermediate and reflective morphodynamic state.

In general, the study was successful to prove that the morphodynamic of the beach are different from a place to another. From all factors studied in this project, it is concluded that the beach morphology undergoes perpetual and rapid changes. Natural forces and anthropogenic effects such as breakwater installation, tourism activities and residential aspect is the key factors in influence the substantially modification the shape of the beach.

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**MORFODINAMIK PANTAI DAN JENIS SEDIMEN DI BEBERAPA  
KAWASAN DI SEPANJANG PANTAI DI WILAYAH TERENGGANU**

**NORAISYAH BINTI SAPON**

**December 2011**

**Pengerusi : Profesor Madya Rosnan Yaacob, Ph.D.**

**Ahli-ahli : Profesor Madya Khalid Samo, Ph.D.  
Nor Antonina Abbdullah, Ph.D.**

**Institut : Institut Oseanografi dan Sekitaran**

Pengetahuan mengenai proses pesisir pantai adalah diperlukan untuk memahami sepenuhnya tentang rangka proses penimbunan dan hakisan pantai. Tujuan utama kajian ini ialah untuk mengenalpasti proses – proses yang terlibat di kawasan kajian dalam tempoh kitaran satu tahun. Pengukuran profil pantai dan penyampelan sampel sedimen telah dijalankan pada selang masa dua bulan disetiap stesen kajian. Semasa monsun timur laut, pantai dipengaruhi oleh ombak dan arus yang deras. Walau bagaimanapun, daya hidraulik yang sederhana dan rendah dengan kekuatan ombak dan arus yang agak lemah dikenalpasti ketika musim monsun barat daya.

Pengukuran profil pantai menunjukkan bahawa pantai di kawasan kajian mengalami perubahan yang dinamik sepanjang tempoh satu tahun tinjauan. Semasa monsun timur laut, kebanyakan bahagian depan pantai terhakis dengan proses limpahan ombak menyebabkan berma dibawa ke bahagian atas dan lebih ke darat. Sedimen dari bahagian tepi pantai yang terhakis dibawa ke gigi air di mana arus bujukan pantai seterusnya mengangkut sedimen tersebut ke arah hanyut turun ke lokasi penimbunan. Pada musim monsun barat daya, proses penimbunan adalah dominan kerana tiada

daya ombak yang kuat. Dengan ini, gelombang-gelombang ombak dapat membina semula pantai tersebut.

Kebanyakan sedimen pantai di kawasan kajian secara amnya terdiri daripada partikel pasir pertengahan kasar berdasarkan pengkelasan nilai  $\phi$ . Walau bagaimanapun sedimen ini menjadi bertambah kasar iaitu berjulat di antara pasir sangat kasar dan sederhana kasar semasa monsun timur laut disebabkan arus ombak yang lebih tinggi membawa sedimen yang bersaiz halus ke arah hanyut turun, meninggalkan sedimen yang lebih kasar ( $-0.24 - 1.69 \phi$ ). Sedimen pantai semasa monsun timur laut mempunyai sisihan yang tidak sempurna dan nilai kepencongan negatif berbanding dengan musim luar monsun di mana sedimen adalah lebih halus ( $1.51 - 2.73 \phi$ ), sisihan sederhana sempurna dan nilai kepencongan yang positif. ( $-0.15 - 2.30 \phi$ ). Pentafsiran bagi sampel-sampel dari aras pasang-surut yang berbeza menunjukkan bahawa perubahan permukaan pantai adalah bergantung kepada bentuk dan tahap kekuatan tenaga yang bertindak di setiap bahagian aras pantai tersebut.

Sedimen bersaiz kasar dan daya ombak yang lebih tinggi semasa monsun timur laut juga menyebabkan bentuk pantai yang curam berbanding semasa luar musim monsun, di mana ombak yang rendah dan sedimen lebih halus menyebabkan pantai lebih landai. Julat darjah kecerunan pantai adalah di antara  $2.11^\circ - 17.48^\circ$ . Terdapat hubungan atau perkaitan yang jelas di antara darjah kecerunan pantai dan juga kandungan saiz partikel. Hubungan yang agak ketara ditunjukkan di aras zon tengah (*mid-tide*) yang mana menjelaskan bahawa peningkatan darjah kecerunan berkadar terus dengan peningkatan saiz sedimen.

Analisis statistik taburan saiz sedimen muara berdekatan dengan kawasan kajian juga dilakukan memandangkan muara merupakan sumber pendedapan utama kepada persekitaran pantai. Hasil gabungan antara sedimen muara dan pantai menunjukkan terdapat perkaitan dari segi jenis sedimen. Ini secara tidak langsung menyatakan bahawa kepelbagaian jenis sedimen pantai adalah dipengaruhi oleh faktor tenaga sumber (muara) yang mengangkut sedimen di sepanjang pantai.

Di dalam kajian ini juga, satu langkah dalam mengelaskan pantai-pantai kajian dari segi kriteria morfodinamik telah berjaya dicapai walaupun terdapat pembatasan dalam keupayaan sesetengah parameter dalam pengelasan tersebut. Namun, dapat dikelaskan bahawa kebanyakan pantai di kawasan kajian terdiri daripada kelas pertengahan (*intermediate*) dan cerun (*reflective*).

Secara amnya, kajian ini telah berjaya membuktikan morfodinamik pantai adalah berbeza dari satu tempat dengan tempat yang lain. Dari pelbagai faktor yang telah dikaji di dalam projek ini, dapatlah disimpulkan bahawa morfologi pantai sememangnya sentiasa berubah. Faktor semulajadi dan kesan aktiviti manusia seperti pembinaan pemecah ombak, aktiviti pelancongan dan juga penempatan tepian pantai ialah faktor penting dalam mempengaruhi perubahan bentuk pantai.