Coir (Coconut Fiber)
An Abundant Natural Fiber Resource to Save the Earth, its Waters and Wetlands

RoLanka International, Inc. 1994

"Wetlands" is the collective term for marshes, swamps, bogs and similar areas that often develop between open water and dry land. Until recently, the wetlands were considered as dangerous, mosquito-infested wastelands. Due to this negative view, more than half of the America's original wetlands have been destroyed. With increased understanding of ecological processes, the attitude towards wetlands has changed. Scientists have discovered that wetlands are, in fact, valuable natural resources that provide important benefits to people and their environment. Wetlands are among the most productive ecosystems, providing important sources of food for people as well as for wildlife. In their natural conditions, wetlands provide wildlife habitats, improve water quality, reduce flood and storm damages, control sediment and shoreline erosion, maintain water supply, produce timber, and provide a place for recreational activities. Thus wetlands are not wastelands, but they are natural wonderlands.

Soil erosion has been identified as the main source of water pollution. Runoff sediment accounts for more than two-thirds of all pollutants entering the U.S. waterways. The runoff sediments increase turbidity, reduce water holding capacity and create problems for aquatic organisms. Toxic heavy metal contaminants which can adhere to these sediments may enter our waters and cause toxicity problems. The adverse effects of erosion on wetlands have heightened awareness of the need to clean up and restore soils, waters and wetlands.

A number of laws have been mandated in the U.S. to overcome these problems. Irrespective of the legal mandates, every human being is responsible for protecting the earth and its environment. Thus, it is time to educate the general public about the importance of protecting earth, its waters and wetlands. As human activities have created great threats to the environment, every reasonable human measure to prevent as well as to correct environmental problems should be taken. Any measure that will satisfactorily

1

prevent or control the targeted problem but create additional environmental danger will not be a viable solution for today's environmental needs. Therefore, it is time to concentrate on cost effective, environmentally safe methods to prevent and correct environmental problems.

The use of natural fibers for erosion and sedimentation control dates back to the beginning of this century. The main problems in the early natural fiber erosion control blankets (example Jute Mats) were low tensile strength, high elongation and low durability. These drawbacks restricted their use to only less severe erosion problems. An alternate natural fiber that has drawn the attention of the erosion and sedimentation control industry is **coir**, the coconut fiber.

Coir is processed from the husk of the fruit from the coconut tree (*Cocos nucifera*), which is a tall palm tree native to East India (Plate 1). The coconut fruit is a large oval shaped fruit with a fiber husk and a hard shell that encloses the edible meat and milky fluid. The milky fluid in young coconut fruits is a great tasting drink. The white edible meat of coconut fruit is a popular ingredient in many dessert recipes. In addition to the edible meat, the entire tree is very famous for multiple uses. Coconut leaves are used as a roofing material in temporary sheds, while the leaf stems are used for fire wood. The trunk of the coconut tree is an elegant interior decorating wood as well as excellent roofing lumber. The hard shell is burned, and the charcoal is used for activated carbon products.

Plate 1: Coconut trees

The traditional way of processing coir starts with curing the coconut husks in water for 6-7 months. Large curing pits are generally used and husks are added in one end and the cured husks are retrieved from the other end. Curing of husks in water increases the flexibility of coir fibers and also has

been found to increase their durability. The soaked husks are machine processed for coir. During processing, initially separated fiber is called mattress fiber coir. This coir is very short, thin and flimsy. It is a good mulching agent. The next type of coir separated from the husk is called omat coir fiber. The fibers in this coir type are fairly long and strong. Once the mattress fiber coir and omat coir fiber are separated, the remaining coir is called bristle fiber coir. The fibers in this coir type are longer and stronger compared to the other two types (Plate 2). Of these three types, the bristle fiber coir has the highest lignin content and the highest density. As a result, the bristle fiber coir has the highest resistance to rotting and the highest strength compared to the other two coir types.

Plate 2 – Coir fibers

Bristle coir fiber **Mattress coir fiber**

These different types of coir are used for different purposes. The mattress fiber coir is used in mattresses and other seat cushions. It is also used in low strength coir twines, coir door mats, coir baskets, coir rugs and coir wall hangings. The bristle fiber coir is generally used to manufacture coir brooms, coir brushes, heavy duty coir twines and coir ropes.

The coir has been used in European countries for many years as one of the main raw materials for erosion and sedimentation control and wetland management. With the overwhelming success of coir erosion control and wetland management products in most of the European countries, these coir products have been recently introduced to the U.S. market. The first coir erosion control product introduced to the US market was a coir-polypropylene netted blanket. In this blanket, the mattress grade coir is sewn into two polypropylene nets by polyester threads. This blanket has considered superior in the category of fiber-plastic netted blankets. The main reason for its success is the durability of mattress grade coir.

Mattress grade coir lasts 3-4 years in the field before complete decomposition; whereas, similar products with straw or wood shavings lasts only 1 to 2 years. In general fiber-plastic netted blankets have low tensile strength.

The second type of coir erosion control product introduced was a woven coir erosion control blanket (Plate 3). This fairly new blanket is woven from the spun coir twines, and many people have mistakenly thought that it has similar properties as jute blankets. The type of coir used in twines will have a direct effect on the performance of woven coir blankets. The mattress grade coir twines will produce a lower quality blanket compared to bristle coir twines. In general, the material cost of bristle fiber coir is 3 to 4 times higher than mattress fiber coir. Many manufacturers of erosion control products avoid the use of bristle fiber coir in their products solely due to its extra cost. The woven erosion control blankets with bristle fiber coir twines last 5 to 10 years in the field depending on the application. These erosion control blankets have the highest durability, the highest tensile strength, the lowest elongation and the highest weight among all types of organic erosion control blankets. Another outstanding feature of these woven coir erosion control blankets is the absence of synthetic materials in the matrix. This 100% organic, but highly durable and strong, erosion control blanket seems to provide the natural solution needed for today's environmental problems. This coir product is a valuable tool for bioengineers as well as everyone who wishes to use natural solutions for tough erosion problems. The woven bristle fiber coir erosion control blankets will allow designers to go beyond the limits of the other types of organic erosion control products.

The coir erosion control blankets have the capability to cover a broad spectrum of erosion problems. The low tensile strength mattress fiber coir-polypropylene netted blankets are excellent for situations involving moderate erosion problems, whereas the high tensile strength bristle coir blankets are excellent for situations involving severe erosion problems. Tensile strength (wet) of the woven bristle fiber coir erosion control blankets (Machine Direction (MD) 100-140 lbs/in, Cross Direction (CD) 80 lbs/in) are considerably higher than the tensile strength of most of the synthetic blankets (MD 10-25 lbs/in,

CD 5-20 lbs/in). Elongation-at-failure of these blankets range from 35-45%; whereas, synthetic blankets have elongation- at-failure as high as 70%. The woven bristle fiber coir blankets also are very heavy compared to synthetic blankets. Heavy weight in these blankets acts favorably in the process of erosion control compared to the light-weight synthetic blankets. The woven coir erosion control blankets have higher flexibility than synthetic blankets; thus, these blankets are easier to install and have fewer tendencies for failures due to poor installation. Therefore, these woven bristle fiber coir erosion control blankets are a much better solution to erosion problems compared with synthetic erosion control blankets specified at present.

Plate 3: Woven coir mats

Woven mattress coir mat

Woven bristle coir mat

Coir erosion control blankets are completely biodegradable and overcome the main drawback in synthetic blankets. The argument that permanent synthetic mats (turf reinforcement mats) are required under the vegetation for successful erosion control may be a viable engineering solution; however, it is not a viable ecological solution. Permanent synthetic blankets under a well established vegetation cover interfere with future activities such as mowing and digging which might be essential to maintain natural beauty. An artificial blanket under a vegetation cover also will act as a barrier to soil organisms in their seasonal migrations which creates threats to the ecosystem and may causing an imbalance in the system. The ecologically safe answer for this situation is to select a grass variety that can establish a sustainable plant community in a reasonable time period, that has a prolific leaf growth to intercept rain and wind and

that have a deep, strong root system to resist heavy runoff water. If the currently available grass varieties do not carry these capabilities, the trend should be geared towards developing a suitable grass variety for this purpose. The present plant biotechnological methods are so advanced that this should not be a difficult task.

Coir erosion control blankets absorb 150-200% water by weight without swelling like paper, wood shavings or jute erosion control blankets. The water absorption capability of coir blankets promotes seed germination and seedling growth and prevents topsoil from drying out. Thus, these blankets are a better medium to establish vegetation than the synthetic blankets. With time, the biodegradable coir blankets become mulch which improve the soil composition and reduce water evaporation losses. These coir erosion control blankets account for adding mulch at a rate of 7800-9800 lbs/ac. In addition to the biodegradability, strength and durability of woven coir erosion control blankets; these blankets also are aesthetically pleasing to apply and are less expensive than most synthetic blankets.

Until recently, design engineers used rock riprap and concrete structures to correct shoreline and streambank erosion. Even though these methods may correct the targeted problems, they do not allow normal ecological phenomena to occur. Coir products also have been introduced to protect against shoreline and streambank erosion and to restore damaged wetlands. These products are made of mattress grade coir that is compacted into a cylindrical shape and enclosed in a coir twine casein. These cylindrical structures are used to revegetate native non-woody bog plants along water edges. This new bioengineering technique has become a viable option due to the fact that the mattress grade coir is a good plant growth medium. The wetland boarder created along the water edges will provide habitat for wildlife and improve water quality by removing and retaining nutrients, processing chemical and organic wastes and reducing sediment loads to receiving waters.

In recent years, the use of coir products for soil bioengineering and wetland management has grown considerably, and the introduction of new coir products for the market is on the rise. The latest product introduced to the market is a coir blanket made of mattress grade coir. This blanket uses a

synthetic latex as a binder to glue the coir together. This is the technique that has been used in making coir mattresses for the last several decades. Thickness of this blanket is 2 in, and the latex holds the coir together; whereas, in coir-polypropylene netted erosion control blankets, polypropylene nets and polyester threads hold the mattress coir in place. This development opens the way to a very promising series of coir products for erosion control and bioengineering applications. With increasing confidence in and acceptance of coir products, more and more quality coir products will be introduced into the market in the future.

The different coir types and their characteristics have made coir the most versatile natural fiber to combat erosion and to restore waters and wetlands. Thus, coir seems to be the miracle fiber of this century to save the earth, its waters and wetlands.