HILLS TECHNOLOGY VS CONVENTIONAL TECHNOLOGY

This paper is intended to briefly summarize the capabilities of Hills Technology for multi-component fiber production vs. conventional multi-component technology.

EXPERIENCE IN MULTICOMPONENT. Hills' worldwide experience in all types of multi-component fiber production is clearly without equal by others. Our Customers are commercially producing bicomponent and tricomponent fibers with more complex cross sections, more polymer types, and with more extreme polymer ratios than with any other available technology. Our experience includes multi-filament, staple, monofilament, spunbond and meltblown applications. This is all based on our own technology, not technology borrowed from others such as fiber producers. We continue to aggressively develop our technology without needing to rely on the creativity of others. No one can claim the broad multi-component fiber technology know how possessed by Hills

SCOPE OF SUPPLY. The Hills scope includes a proven mult-icomponent spinbeam with independent temperature controls for each polymer system. If multi-component spin packs are purchased from a spinpack manufacturer, the spinbeam would need to be supplied by others or developed by the purchaser.

COMMERCIAL STYLE DESIGN. The Hills multi-component spin beam / spin pack design is based on the same threadline layout as is used in today's best commercial designs for homopolymer fiber production. Examples of commercial applications of Hills multi-component technology include: filament applications with eight threadlines on ~800mm gauge, staple applications in the largest rectangular and radial pack configurations, spunbond systems with spin packs over 4 meters wide and with over 6000 holes/ meter, and meltblown systems with over 1000 holes/meter. The Hills designs allow practically all multi-component fibers to be commercialized with conventional downstream equipment (quench, take-up, etc.). It is even very practical to retrofit Hills Technology into most existing homopolymer spinning lines. No other equipment manufacturer has such designs, and such designs are often not practical with competitive technology.

POLYMER RESIDENCE TIME. The Hills Technology uniquely allows a much shorter polymer residence time (much less than half the time in most cases) in the spinbeam and the spinpack. This short residence allows for much greater temperature separation between the multi-polymers and between any polymer and the process equipment. This creates the ability to run a much broader array of materials, lower deniers, and wider polymer ratios than can be achieved with competitive technology. This fact is especially significant where low polymer ratios or temperature sensitive polymers are used.

HIGH SPINNERET HOLE DENSITY. With the Hills Technology, the spinneret hole density (filaments/threadline in filament applications) can usually be about the same as with homopolymer spinning. With competitive technology, as the cross sections become more complex, it becomes necessary to reduce the spinneret hole density, due to both the spinpack machining cost and the impossibility of manufacturing such fine spinpack details by conventional techniques.

SPINNING TEMPERATURE CONTROL. Hills Technology allows much better temperature control between threadlines due to several factors, including but not limited to the following: A. Small spinneret area. Hills Technology allows a much smaller spinneret area, minimizing heat loss due to radiation and air currents. This small area also results in a higher polymer flow per unit area of the spinneret which helps to maintain the spinneret at the temperature of

the polymer. B. Bottom loading design. This eliminates chimney currents that cool the spinpack, and it allows for much greater thermal contact between the spinpack and the spinbeam. Conventional multi-component spin packs are often too large and heavy to be conveniently handled in bottom loading applications.

CROSS SECTION COMPLEXITY. Hills Technology allows for the manufacture of Multi-component fiber cross sections that are much more complex than can be achieved with conventional technology. For example, in bicomponent production, Hills has already demonstrated >1000 islands-in-a-sea on conventional spinneret hole density. Such complex cross sections are either impossible or simply too expensive to produce with conventional technology. For example, in the well-known bi-component filament products, the difference in spinpack cost between 24 filaments / thread line with 36 islands/filament vs. 36 filaments / thread line with 64 islands/filament is insignificant when using Hills Technology.

PRODUCT FLEXIBILITY. Hills Technology uniquely offers the opportunity to economically produce a virtually unlimited number of new products on the original equipment. This is in part due to the relatively low cost of alternate polymer distribution plates when using Hills Technology. Modifications can be economically made for simple product variations, such as changes in polymer ratios or polymer types, or for complete product cross section changes to meet and create new market requirements or for use with new polymers. Such product flexibility is either impossible or prohibitively expensive with conventional technology.

SPEED TO MARKET. Hills is installing the capability to convert a Customer's new development ideas or product requirements into commercial spin pack components within days. This requires weeks or months with conventional technology, assuming that production of the new product concept is even feasible with conventional technology. Furthermore, Hills has it's own in-house fiber extrusion equipment and laboratory which are used by Hills, Customers, universities, material manufacturers, and others in the rapid development of new fiber products or new materials in multi-filament, staple, mono-filament, spun bond, and melt blown applications. No other equipment manufacturer comes close to this same in-house capability in multi-component fiber spinning. Development efforts by Hills and others in our labs routinely resulting in new commercial developments that are not achievable with conventional technology.

UNLIMITED SPINNERET SIZE AND GEOMETRY. While a Hills Customer's initial project may be for a specific type of spinning process such as multi-filament, our Customers often find it advantageous to apply their developments to other spinning processes such as spun bond. With Hills Technology, it is economically practical to apply most newly developed products to other processes that require much larger or varied geometry spinnerets for commercial use. This same flexibility does not exist with competitive technology.

ANALOGY. Finally, many of the above advantages result from the fact that Hills uses technology similar to printed circuit board production to manufacture the polymer metering and distribution plates. This is as compared to the conventional techniques of milling, drilling, EDMing, lasering, etc. used by competitive manufacturers. Comparing multi-component fiber technology with systems using printed circuits is really quite appropriate. In both instances, the process needs to precisely route multiple streams to many places in as small a space as possible. Furthermore, emerging technology and varying market demands require both processes to be extremely flexible in converting to future products. The reader can appropriately think of the Hills Technology like a modern cell phone - compact, flexible, and with virtually unlimited programming capabilities. The conventional technology is analogous to the old rotary dial phone - large, inflexible, and with very limited capabilities. After

understanding the advantages of Hills Technology, it seems practically impossible for any decision maker, whether from a commercial or technical perspective to prefer anything else.