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EFFECT OF SOME PROCESS PARAMETERS ON ACRYLIC YARNS AND KNITTED FABRICS MADE OF THOSE YARNS

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ABSTRACT: High bulk acrylic yarns having relax and unrelax fibre blends with varying ratios are commonly used for knitted fabrics. Within acrylic yarn production, bulking process parameters and blending ratio of relax and unrelax acrylic fiber have considerable effect on the desired yarn volume as well as on optimum yarn properties. This study aimed to investigate the effect of ply twist (tpm), bulking temperature (°C) and bulking machine velocity (m/sec) on acrylic yarn properties as well as on supreme knitted fabric properties from those yarns where a constant blend ratio of relax/unrelax acrylic fibre blends were utilized. For this purpose, three different ply twist (185, 215 and 245 tpm) and bulking machine velocity of three levels (550, 650 and 750 m/sec) were selected. Bulking process was achieved at 110 and 130 °C. Tenacity, elongation, crimp contraction and shrinkage properties of untreated acrylic yarns and of acrylic yarns treated with bulking process were evaluated. Additionally, weft knitted fabrics from those yarns were produced at constant production parameters. Bursting strength, air permeability and pilling properties of acrylic knitted fabrics were compared. In order to obtain the optimum ply twist, bulking temperature and bulking machine velocity regarding to desired yarn and fabric properties, numerical optimization method was used at 5% significance level. According to the test results; it was concluded that ply twist, bulking temperature and bulking machine velocity had significant effect on yarn shrinkage. In addition, interaction of ply twist and bulking temperature was found to be an influential factor on bursting strength, bursting distention and air permeability properties. As a consequence, desirability ratio with the value of 57.2% could be provided for the fabrics with the acrylic yarns produced at 185 tpm ply twist with 614 m/sec bulking machine velocity at 130 °C bulking temperature.

Keywords: Acrylic fibre, bulking process, high bulk yarn, knitted fabric, optimization.

AKRİLİK İPLİKLER VE BU İPLİKLERDEN ÜRETİLEN ÖRME KUMAŞ ÖZELLİKLERİNE BAZI ÜRETİM PARAMETRELERİNİN ETKİSİ

ÖZET: Değişen oranlarda relakse ve relakse olmamış akrilik liflerin karıştırılmasıyla üretilen yüksek hacimli akrilik iplikler örme kumaşlarda yaygın olarak kullanılmaktadır. Burada, şişirme işlem parametreleri ve relakse/relakse olmamış akrilik liflerinin karışım oranı, istenen iplik hacmi ve optimum iplik özellikleri üzerinde önemli etkiye sahiptir. Bu çalışma kapsamında, sabit karışım oranında relakse/relakse olmamış akrilik lifleri kullanılarak farklı kat bükümünde (tpm), şişirme sıcaklığında (°C) ve şişirme makine hızında (m/sn) üretilmiş iplikler ve bu ipliklerden üretilen örme kumaş özellikleri belirlenmeye çalışılmıştır. Bu amaçla, üç farklı kat büküm (185, 215 ve 245 tpm) ve şişirme makine hızı (550, 650 ve 750 m/sn) seçilmiştir. 110 ve 130 ° C'de şişirme işlemi gerçekleştirilmiştir. Şişirme işlemi yapılmamış ve yapılmış iplik numunelerinin mukavemet, uzama, kıvrım kısalması ve çekme özellikleri belirlenmiştir. Bu iplikler kullanılarak sabit üretim parametrelerinde atkılı örme kumaşlar üretilmiştir. Kumaş numunelerinin patlama mukavemeti, patlama uzaması, hava geçirgenliği ve boncuklanma özellikleri belirlenmiştir. İstenilen iplik ve kumaş özelliklerine göre optimum kat bükümü, şişirme sıcaklığı ve şişirme makine hızını elde etmek için %5 önem seviyesinde sayısal optimizasyon metodu kullanılmıştır. Test sonuçlarına göre; kat bükümü, şişirme sıcaklığı ve şişirme makinesi hızının iplik çekme özelliği üzerinde önemli bir etkiye sahip olduğu belirlenmiştir. Buna ek olarak, kat bükümünün ve şişirme sıcaklığının etkileşiminin patlama mukavemeti, patlama yüksekliği ve hava geçirgenliği üzerinde önemli bir etkiye sahip olduğu bulunmuştur.

Sonuç olarak, istenilen hedefe ulaşma oranı %57,2 olan, 185 tpm kat bükümlü 614 m/sn şişirme makinesi hızında ve 130 °C şişirme sıcaklığında üretilen akrilik iplik ve bu iplikten elde edilen örme kumaşta sağlanmıştır.

Anahtar Kelimeler: Akrilik lifi, şişirme prosesi, yüksek hacimli iplik, örme kumaş, optimizasyon.

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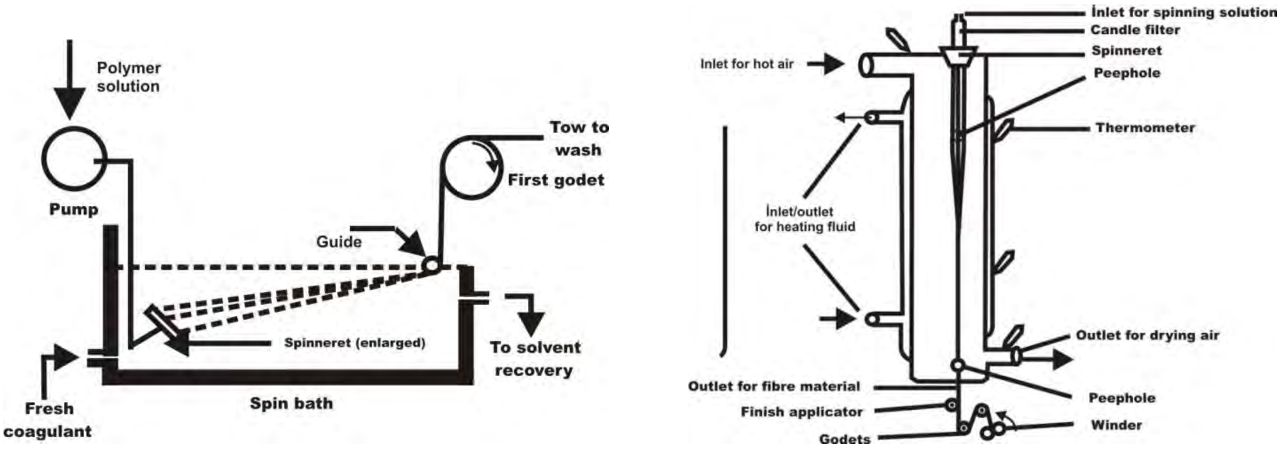
1. INTRODUCTION

Due to the low cost of "acrylonitrile", acrylic fibre gained importance with its resemblance to wool yarn character for the knit wears. There has been a great tendency especially towards the high bulk yarn production where the yarn volume is increased which results with the improvement in handling, covering and thermal insulating properties of end products [1]. Exploratory studies on comparison of acrylic based bulk yarns produced in different spinning systems are available in literature. During the 1950's, at least 18 companies had focused on acrylic fibre production. However, during 1970's there has been rapid growth of acrylic fibre production in Japan, Eastern Europe and developing countries [2]. Most of the acrylic fibres are spun by dry spinning in which the removal of solvent in hot air results with fibre forming or by wet spinning in which the fibre is formed by a diffusion process. Simple schematic of an acrylic fibre in wet (a) and dry (b) spinning is indicated in Figure 1. Melt spinning is not commercially applied owing to acrylic fibres decomposing before their melting points.

For tow end-uses of the acrylic fibres, the fibres from each spinning cell on each half of the machine are combined together making a large tow of up to 500 000 dtex. These are drawn off by take-off rollers at speeds of 250–450 m/min, prior to collection in spin cans. The second stage of acrylic production includes a series of some processes such as drawing, washing, finishing, drying, and crimping. The crimped tow is later cut to different staple lengths for staple spinning [1, 3-5].

Bulking mechanism is obtained by utilizing the difference in shrinkage power of acrylic fibres which results with a modified structure of the spun yarns known as high-bulked structure [6]. Piller (1973) presented a model for the position of unrelaxed and relax fibres in high bulked acrylic yarn. When the acrylic yarns are exposed to heating relaxation conditions by steaming or hot air treatment, the shrinkable fibre groups' contract and non-shrinkable fibres move towards the yarn surface (Figure 2).

Bulking mechanism in high-bulk yarns depends not only on contractile properties of fibres' shrinkage properties but also on the interaction of two components (relaxed-unrelaxed) within the yarn. The yarns' internal structure factors including fibre blend proportions, yarn twist, radial distribution of the two components relative to the yarns axis are influencing factors for the acrylic yarn properties.



(a) (b)

Figure 1. Schematic view of wet spinning (a), dry spinning (b) [2].