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学位論文題目	Study on the relationship between fabric bending rigidity and yarn properties (糸の特性を考慮した布の曲げ剛性に関する研究)
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## 論 文 内 容 の 要 旨

In this study, the relationship between fabric bending rigidity and yarn properties such as yarn bending rigidity and yarn torsional rigidity was investigated. The Cooper model was verified and the effect of crimp on yarn torsional rigidity was investigated. This study can be used to improve the simulation of textiles properties.

In Chapter 1, a background of the work on fabric and yarn properties was given.

Chapter 2 exposed a literature review of the previous studies and published papers on the subject of yarn properties and assessment and presented the general mechanical theories regarding bending properties of fabric as well as torsional and bending rigidity of yarns. The existing methods of assessment of this properties were also developed in this chapter.

In Chapter 3, the effect of yarn torsional rigidity on the Cooper model for fabric bending rigidity in any direction was verified. Five commercial fabrics were first used as experimental samples. Then, an additional five cotton fabrics with different weft densities were woven. The torsional rigidity of yarn from the bobbin and that of yarn directly extracted from fabric were measured with a yarn torsional tester. The bending rigidity of yarn from the bobbin was measured using the same pure bending tester as used in fabric bending testing. The bending rigidity of the fabric was calculated using torsional rigidities of yarns extracted from the fabric and showed better agreement with the experimental values than that calculated using the torsional rigidity of yarn from the bobbin. Indeed, measurements showed that the torsional rigidity of yarn from the bobbin was appreciably higher than the torsional rigidity of yarn from the fabric. This is due to the crimp in the yarn. The fabric bending rigidity was able to be predicted using the Cooper model with torsional rigidities of yarns extracted from the fabric.

In Chapter 4, following the previous chapter, the effect of crimp on torsional rigidity of monofilament and cotton spun yarns was investigated. Two kinds of polymeric monofilament yarns and four kinds of cotton spun yarns were examined. Different crimps were applied to the yarn using an original crimp setting equipment. To fix the crimp, the polymeric monofilaments were treated with heat and the cotton spun yarns were treated with steam. The test samples were then produced following two protocols: with or without the application of weight. The yarn torsional rigidities with crimp were measured using a torsional measurement device and were compared with those without crimp. Almost no weight was applied to the cotton spun yarns to

preserve the crimp during testing. The results with and without the application of weight were compared. For the monofilament yarns, the torsional rigidities of the crimped yarns had a linear relationship with the crimp ratio. For the cotton spun yarns, the torsional rigidities of the crimped yarns were smaller than those of the straight yarns. The smaller the yarn count, the smaller the yarn torsional rigidity. The effect of crimp on torsional rigidity differed according to the yarn counts. There was almost no difference in crimped yarn torsional rigidity between the straightened and non-straightened yarns after crimp setting. Therefore, there is a possibility that the change in yarn properties could have resulted from the bending of the fiber during crimp setting and not from the shape of the crimp afterwards.

In Chapter 5, the conclusions of this study were given. Recommendations for future work were also given.