# TO MAINTAIN UNIFORM PRESSURE BETWEEN TWO ROLL PADDER IN STENTER MACHINE: A REVIEW

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## Abstract

In present review paper finite element analysis (FEA) technique is adopted to support the design of rubber covered two roll padder used in Stenter machine for squeezing application. Rollers bend due to the force acting on two ends and due to gravity hence pressure distribution along the nip is different. Design of two roll padder should be such that to maintain uniform pressure along the nip of rollers. This helps to reach the optimum solution for squeezing purpose and also reduce the load for the next drying application. A model is developed and by using efficient algorithm, effect of bending at the nip for pressure distribution is determined. The other options to achieve uniform pressure are crowning, additional support roller and internal bearing.

**Keywords- Stenter machine, Two roll padder, FEA, Crowning**

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## 1. Introduction

The global textile industry is metamorphosing, with the advent of an increasing number of international players. This has created a need for modern production processes that conform to global standards. Moving in this direction, many companies offer a sophisticated Stenter, which meets the demands of textile finishing globally. In stenter, mostly all types of fabric are processed and main functions of stenter machine are drying, finishing, heat setting, coating, curing etc.

Two roll padder is used in the stenter machine which is used for the finishing processes and dehydration processes. In this system, fabric is allowed to pass between the rollers and get squeezed. Among these two rollers, driven roller is fixed and the other is pressed to the driven roller by means of pneumatic force acting at the ends of rollers.

**Figure 1:** two roll finishing padder

Rollers are covered with the rubber coating and pressure distribution is depends on the stiffness and thickness of rubber. It is necessary to maintain tuning of rubber layer properties with the clamping forces. Weight of roller is to be optimum because it will also affect the bending.

Roller bends due to the pneumatic force and gravity forces. Due to this, pressure variation along the nip of the rollers is different. A model is developed and by algorithm for pressure distribution along the nip is determined. Design of roller is done by using the crowning or additional support rollers or internal bearing, for generating uniform pressure distribution along the nip. FEA technique is used to validate the design of equal pressure two padder rollers.

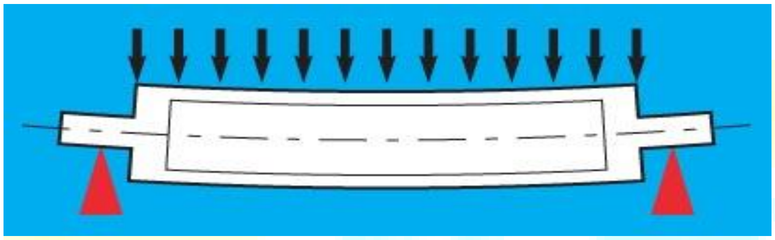


**Figure 2:** Pressure along nip of two roll padder

**2. Literature Review**

To enhance the uniform pressure between two roll padder, the solid model is analysed and experimental results are compared with the FEA results to optimize the design specification and parameter. Therefore, this paper concentrates on the review of modelled and analysed two roll padder.

S.J.L. Van Eijndhoven et al [1] presented a simulation tool to support the design process of systems of flexible, rubber covered rollers. A mathematical model is developed to determine the axial pressure variations in the nips of these systems. In this paper rubber indentation is consider because it is coupled with the bending of roller. A general mathematical model is developed and solved using efficient algorithm to find out the effect of bending on the nip pressure distribution is determined. It includes pressure distribution is depend on the rubber cover stiffness and thickness and also the weight of the roller. Mathematical model is developed for any number of roller and of different profiles and also different boundary conditions. A model is developed using the concept of plane strain problem. To generate the uniform pressure three concepts is used Crowning, Additional roller support and internal bearing. For crowning a mathematical equation is presented to find out the amount of crowning required to eliminate the effect of bending at the nip of roller system. FEA technique is used to validate the result of design.

IizukaYoichiro et al [2] have theoretically investigated the flexible media transport characteristics of crown roller. The purpose of this study is to analyze the flexible media transport characteristics such as longitudinal distribution of nip pressure, traction and transport velocity and so on, and to develop the design method of crown roller that has desired characteristics. Under the assumption of a plane-strain, Green's functions of a rubber roller with a rigid core based on polar coordinates were analytically derived in this method. Coulomb's friction law with constant co-efficient of friction is used. The normal and tangential contact pressures, strain of rubber surface, nip width and indentation depth were iteratively calculated.

In the analysis, two types of crown rollers, i.e. a rubber roller with crown shape in its internal diameter and a steel roller with crown shape in its diameter, were examined. And based on analysis results, a design approach of crown shape which can realize uniform longitudinal distribution of nip pressure was proposed.

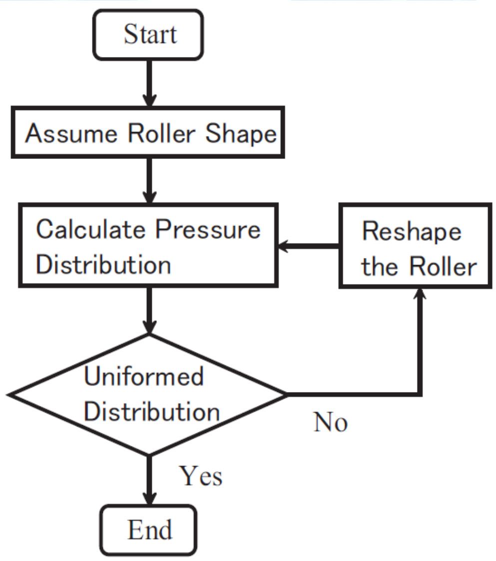



**Figure 3:** Flow chart of crowning calculation

Bo torstenfelt et al [3] studied pressure distribution in crown roller contact. The fatigue life of a roller bearing is heavily influenced by the crowning profile of the rollers. The pressure distribution for different types of crowning has been studied. For solving this three-dimensional contact problem a numerical procedure for analysis of general elasto-static contact problems has been used. The method is based on an incremental and iterative algorithm applied to a set of linear equations established with finite element technique. The contact surfaces are assumed to be perfectly smooth, dry and frictionless. The pressure distribution between the bodies has been compared with results obtained from other methods. The influence on the pressure distribution by the free boundary at the end of the finite cylinders has also been investigated. It is also shown that it is possible to use the same finite element model to study different types of crowning, thus making it efficient to perform parameter surveys. A method of obtaining required or 'optimal' pressure distribution is suggested.

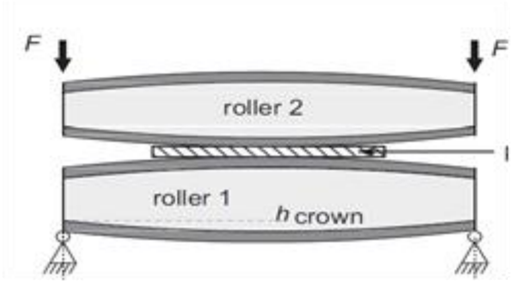
R. Tavakoli et al [4] studied on the steady rolling contact of two elastic layer bonded cylinders with a sheet in the nip. An approximate steady, free rolling contact solution is obtained for two cylinders; each has an elastic layer bonded to a hard core. In the nip, rolling with the cylinders, is a thin sheet with extensional stiffness and no net traction. The criteria for slip is that any two contact points in a contact interface should either have the same velocity, or their shear stress should be equal to the friction coefficient multiplied by the local normal stress. A point-matching method is used to solve the equations. Stress and deformation, as well as surface speed, for the cylinders and the sheet are obtained in series form based on small deflection elasticity theory.

R. C. Batra et al [5] studied on rubber covered rolls. The problem of indentation of rubberlike layer bonded to rigid cylinder and indented by another rigid cylinder id analyzedThe rubber like layer is assumed to be made of a homogeneous Mooncy-Rivlin material. The materially and geometrically nonlinear problem is solved by using the finite-element code developed by the author. Results computed and presented graphically include the pressure profile at the contact surface, stress distribution at the bond surface and the deformed shape of the indented surface.

**3. Methods of application of uniform pressure**

1. **Crowning**: Using the concept of crowning, it is possible to eliminate the effect of bending which further affects the pressure distribution along the nip between two roll padder [1].

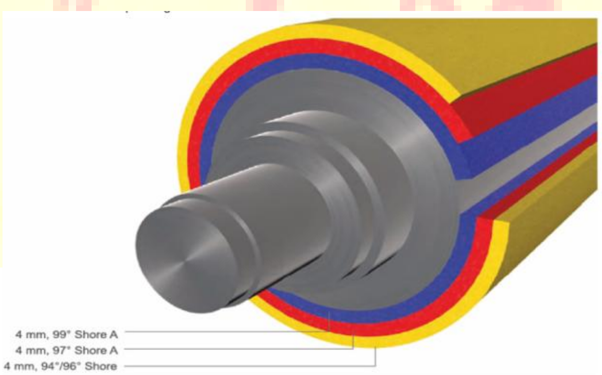
   The mathematical equations are used to find out the amount of crowning required to generate uniform pressure.




2. **Additional roller support**: To reduce the bending, support roller is provided due to which pressure distribution along the nip is almost uniform [1].
3. **Internal Bearing**: Here, internal bearing is provided in one roller, which is on upper side and clamping force is applied normal to this bearing hence pressure distribution along the nip is uniform[1].
4. **Using Triflex elastomer**: The triflex elastomer consists of three rubber layer system results in a high hardness material with outstanding elastic recuperation under high working pressures, making it ideal for the high squeeze positions of the textile finishing padder [7].

- RESULTS

i. Uniform squeezing rate along the nip width
ii. More efficient water squeezing of the fabric.




## 4. Conclusion

From critical literature review, it is concluded that by using simulation and FEA technique it is possible to find out the pressure distribution along the nip of two roll padder. By using the crowning, additional roller support and internal bearing it is possible to generate uniform pressure distribution along the nip of two roll padder. Triplex technology is used to increase the efficiency of squeezing process.

**5. References**

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