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## **Assessing the Impact of Fading Effect by Potassium Permanganate Spray on Cotton-Jute Blended (Jutton) Denim Fabric Panel with Varying Parameters.**

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### **ABSTRACT**

Fashion trend over the world is changing gradually but till here and now washed garments have been reigning with consistency throughout the fashion-sensible wearer. Although the demand for washed denim is always to the fullest but mostly cotton wins the position regarding the raw material of denim. To achieve a variety of raw materials for the huge market of washed denim at the same time to attain the best utility of Jute, this investigation was initiated. Keeping this in mind our main motive was to investigate the usability of Jute-Cotton blended (JUTTON) denim by comparing it with conventional cotton denim after Potassium Permanganate (PP) wash of varying concentration 1%, 2%, 3%. The physical and mechanical properties of Jutton were thoroughly studied by stiffness test, abrasion and pilling test, rubbing and color fastness test, absorbency test as per ISO, AATCC, and British standard. A comparative study is also made with cotton denim panels. The matter of success lies that most of the results are similar in the case of Jutton and Cotton at the same time in a few cases results are outstandingly better for Jutton. From our current experimental works, it can be said that Jute-cotton blended (Jutton) denim can be one of the best alternatives to cotton denim and can open a whole new frontier for fashion seekers.

Keywords: Jutton, denim washing, pp spray, wash effect, fabric diversification

### **1. Introduction**

Now-a-days garments washing has brought about a revolutionary change in the field of fashion and textile industry with its special aesthetic and vintage look. When the term industrial garments wash is uttered, the first and foremost thing that comes to mind is denim washing. Denim is one of the oldest fashion-oriented fabric containing twill weave where the warp yarns are mainly dyed and the weft yarns remain undyed or plain [1]. Although the usual sense the term 'Garments washing' seemingly means to clean up any sort of garments with detergent or any washing agent along with water in assist of hands or washing machine. On the contrary, from an industrial perspective, it comes with a more diversified and elaborated definition. Basically, industrial garments washing is done to modify the appearance, adding a new outlook and as well as to escalate the comfort of the garments [2,3]. As mostly denim is dyed with indigo or vat dyes, washing declares sort of dye destruction even in presence of some mechanical abrasion or any sort of ringing with water. It happens due to the poor fastness properties of these dyes [4, 5]. Nevertheless, washed denim has become a fashion icon in the modern world due to its continuous multidisciplinary appeal such as, reducing size material and creating soft hand feel with improved versatile appearance [6]. When comes to denim fabric composition, mostly cotton wins the position of raw material for long years due to the particular weave formation, comfort, breathability and durability. Particularly, cotton made denim is ruling in the denim sector. As well as blended denim (e.g. Cotton-Polyester, Cotton-Viscose, Cotton-Elastane, Polyamide, Silk is also entering into the arena with satisfactory feedback from consumers [1, 7, 8]. While using man-made or regenerated fibers, it is been always much challenging to

keep it on a row with the environmental issues. For this reason, using natural sources is always preferable. To keep pace with the environmental and economic issues at the same time current fashion entrepreneur is always looking for alternative solutions. And the same way, Jute comes out with significant properties. Jute is considered as one of the abundant fibres in Bangladesh and is named as the Golden fibre [9]. Jute is a bast fiber containing about 58-63% cellulose, 20-24% hemicellulose & 12-15% lignin and some fat, pectin along with aqueous extract [10]. The best thing about Jute is its incredible strength, durability due to its woody composition and its eco-friendly nature due to low water and chemical fertilizer requirements to grow and replenish. Another mighty aspect to move forward jute is its biodegradability. Bangladesh has become a major hub for sourcing denim products for international retailer. With a market share of 27%, Bangladesh is the largest exporter of denim products to Europe, ahead of China. With a 14.20% market share, after Mexico and China, Bangladesh is now also the third largest exporter of denim products in the US [11, 12]. Besides, Bangladesh Denim Expo claims that the global denim market is going to hit about \$64 billion within this 2020 whereas the collective production capacity of Bangladesh is 435 million yards a year with its 30 denim mills [13]. But unfortunately, the total demand is currently 800 million yards a year [14]. It is explicitly visible that there is a huge supply gap and we are capable to meet half of the total demand [13]. In such a deficient condition cotton jute blended denim might rise as a flourishing way to meet the market because Jute costs lower as well as the denim quality from it exhibit competitive performance even for some instance it shows better performance after

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certain wash. When the whole global market is concerned about Environment Friendly garments, at the same time denim washing process requires a huge quantity of water, on that moment Jute-cotton blended denim can be a better environment friendly option to the user in ethical perspective due to its biodegradability and less water uses [15-19].

In this work, it is examined how the quality of denim alters from cotton to Jutton denim after industrial PP wash. In the case of both cotton and Jutton the unwashed raw garments are very stiff, hard and not wearable. Even unwashed garments have low reading regarding color fastness, rubbing etc. So the necessity of wash remains robust in the case of denim. That is why current work proclaims the comparison of the physical properties of cotton and Jutton denim after some range of potassium permanganate spray (i.e, 1% PP, 2% PP, 3%PP).

## 2. Methodology

### 2.1 Materials

#### 2.1.1 Fabric

All the leg panel are made from two types of shell fabric. One is from 100% cotton and another one is jute cotton blended. Both are indigo dyed raw denim fabric. Fabrics were imported from China by Nice Denim Mills Limited, Sreepur, Gazipur.

Others fabric specifications are:

Cotton Denim: 100% Cotton

Jutton Denim: 63% Cotton 37% Jutton (Jute inserted in weft direction)

Dyestuffs: Indigo yarn dyed.

#### 2.1.2 Chemicals used

Potassium Permanganate: Potassium permanganate ( $\text{KMnO}_4$ ) a strong oxidizing agent and used to make color fading effect on denim in washing section.

Sodium Meta-bisulphite: Sodium meta-bisulphite or sodium pyrosulphates is an inorganic compound of chemical formula  $\text{Na}_2\text{S}_2\text{O}_5$ . This is commonly known as Meta. The substance is sometimes referred to as disodium metabisulphite. It is used as a disinfectant, antioxidant and preservative agent. Here it is used to neutral the potassium permanganate. After neutralizing with Meta the effect of potassium permanganate is more visual & prominent.

Antiback, Nearzyme 610, Wetting agent: These chemical have been used as the desizing agent. Removing sizing material & increasing water & chemical absorbency are the main functions of these chemicals.

Gnzymespsuper: This is one kind of enzyme used for removing hairiness of the fabric.

Potash: Potash has been used as the bleaching agent that removes the natural color & other impurities from the fabric.

Belfasinozk: Belfasinozk has been used as the softening agent. This has been used to increase the fabric soft hand feel.

#### 2.1.3 Machineries used:

Spray Gun, Spray rating tester, GSM Cutter, Pneumatic fabric stiffness tester, Universal Testing Machine, Beasley's balance, Electric balance, Washing machine etc

## 2.2 Methods

### 2.2.1 Sample preparation

Leg panel preparation is one of the mandatory steps to follow for denim experimental denim washing trail. There is no standard measurement of making leg panel. For this study we prepared (65 cm × 18 cm) leg panels for conducting all the wash effect and subsequent required tests.

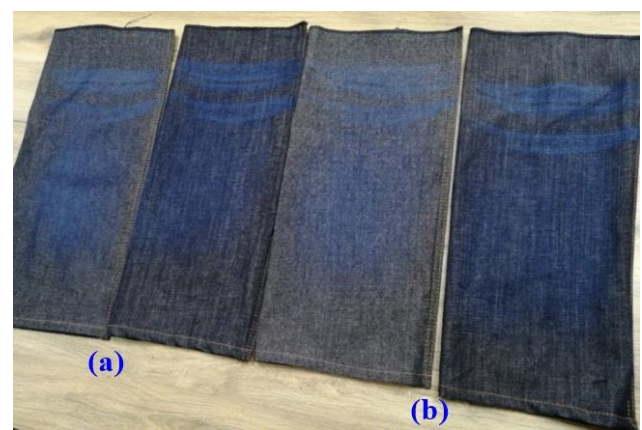


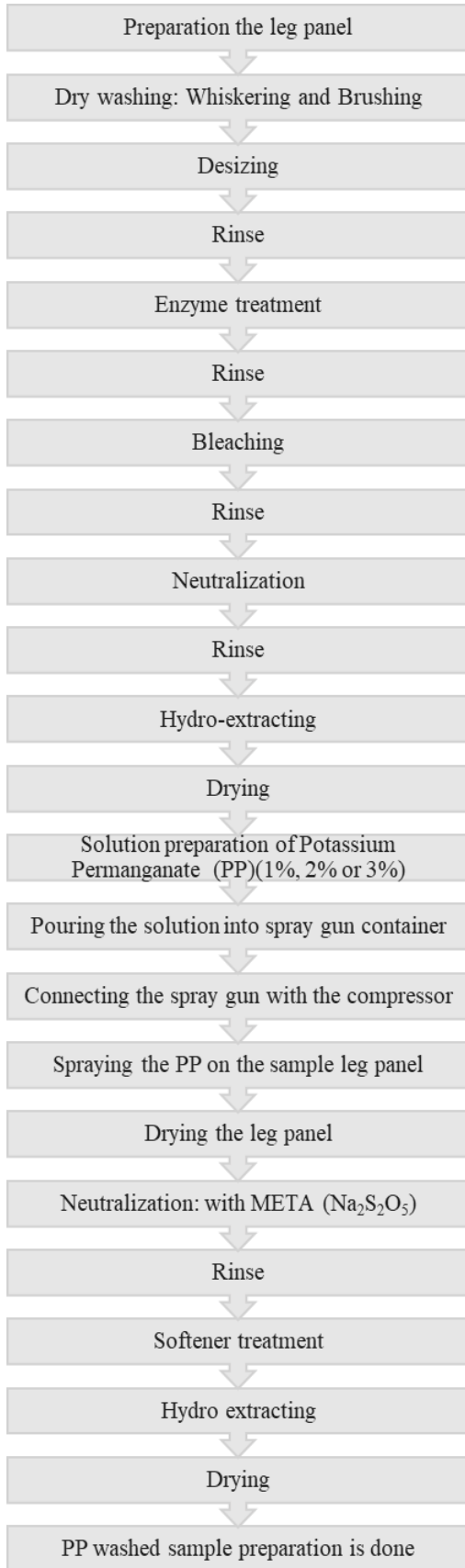
Figure 1: Leg panels (Cotton and Jutton) after whisker effect (Without PP Wash)

Whiskering and brushing were performed on raw denim following below paramaters.

For scrapping emery paper no. : 400 (Red)

For Whisker emery paper no. : 800 (Black)

### 2.2.2 Flow chart of PP Spraying



(a) Cotton Fabric Panel (b) Juttan Fabric Panel

Figure 2: PP treated leg panel with varying concentration

Table 1: Sample making conditions

Name of Process	Chemicals Used	Total kg/gm	Volume of water	Temp (°C)	Time
Dry process (Whiskering & Brushing)					
Desizing	Antiback Nearzyme 610 Wetting agent	2 gm/L 1 gm/L 1 gm/L	50L	55	10min
Rinse-2times water			50L	Room	3 min
Enzyme treatment	Gnzymespsuper Antiback Stone	1 gm/L 2 gm/L 15 Kg	80L	45	30min
Rinse-2times water			50L	Room	3 min
Bleaching	Potash	2 gm/L	50L	50	7min
Rinse-2times water					
Neutralization	Sodium Meta bisulphite	2 gm/L	50L	50	7min
Rinse-2times water					
Neutralization	Sodium Meta bisulphite	2 gm/L	50L	50	7min
Rinse-2times water			50L	Room	3 min
Hydro extracting					
Drying					
PP Spraying (1%/2%/3)					
Neutralization	Sodium Meta bisulphite Antiback	2 gm/L 2 gm/L	50L	Room	5min
Rinse-2times water			50L	Room	3 min
Softener treatment	Belfasinozk	2 gm/L	50L	Room	7min
Hydro extracting					
Drying					

### 3. Result and discussion:

#### 3.1 Effect on GSM, Yarn count and EPI/ PPI:

In this study, all the denim samples' (Raw, Cotton and Jutton) GSM were measured following ASTM D 3776 method.

It was observed that with the increase of PP concentration fabric weight of all the samples reduced, which was expected based on the alkaline effect on cellulosic fibre. Also, with the alkaline effect yarn count of the samples increased and fabric become more compact. It can be depicted clearly from the EPI (Ends per inch) and PPI test, here increase in EPI and PPI is more for Jutton than Cotton. As a result, due to more compactness of Jutton, GSM also increased than Cotton made denim.

#### GSM (Gram square per meter) Test

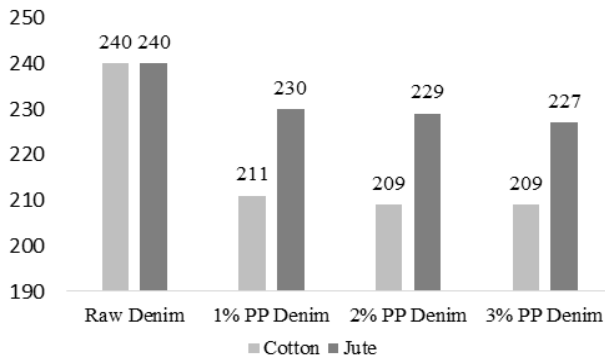


Figure 3: Change in GSM for Cotton and Jutton Denim

#### EPI and PPI Calculation

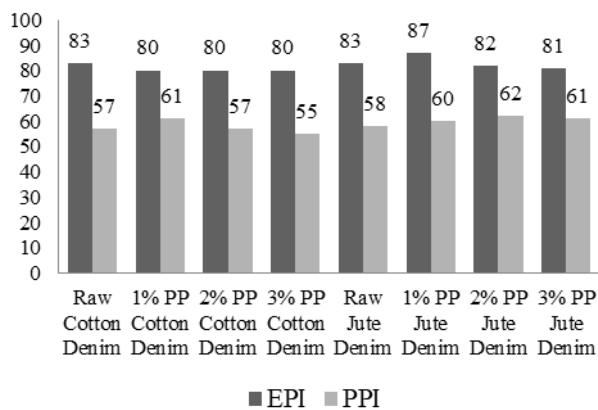


Figure 4: Change in EPI and PPI for Cotton and Jutton Denim

#### Yarn Count Measurement

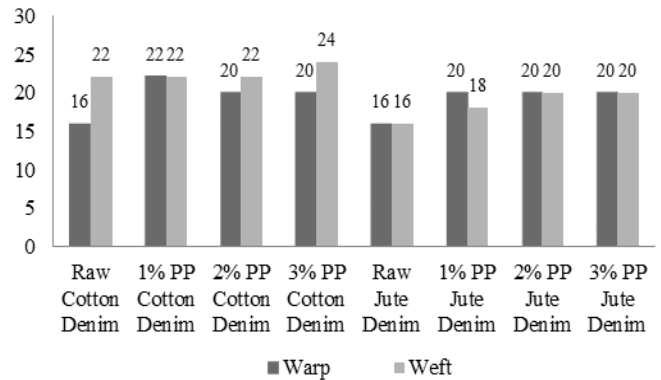


Figure 5: Change in yarn count for Cotton and Jutton Denim

#### 3.2 Stiffness Test:

Stiffness test is performed following ASTM D4032 to check whether, the stiffness is ok for the wearer to regain comfort. From the result it is evident that using jutton denim is more likely similar with cotton. But still a stiffer than Cotton panel. This may be the presence of lingo-cellulosic fibre of Jute.

#### Stiffness Test

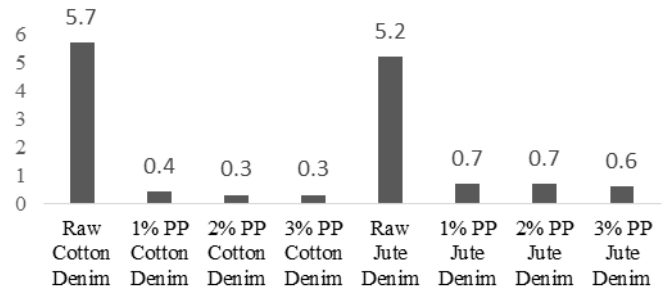


Figure 6: Change in stiffness for Cotton and Jutton Denim

#### 3.2 Color fastness test:

##### 3.3.1 Color fastness to rubbing (Wet and Dry)

Rubbing fastness test was performed based on ISO 105) considering Sample size: 10 cm× 4 cm. It was observed that the dry rubbing fastness was in between acceptable range (fair and good) for both Cotton and Jutton.

### Color fastness to rubbing test in wet & dry conditions

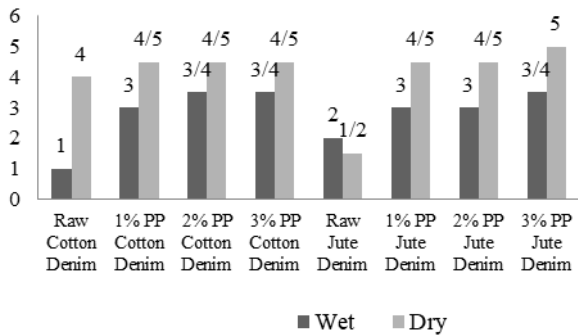


Figure 7: Change in rubbing fastness (wet and dry) for Cotton and Jutton Denim

### 3.3.2 Color fastness to washing

Color fastness to washing test was accomplished following ISO 105-C06 method. It was observed that the

color fastness is also within tolerance and fairly good for all the Cotton and Jutton samples.

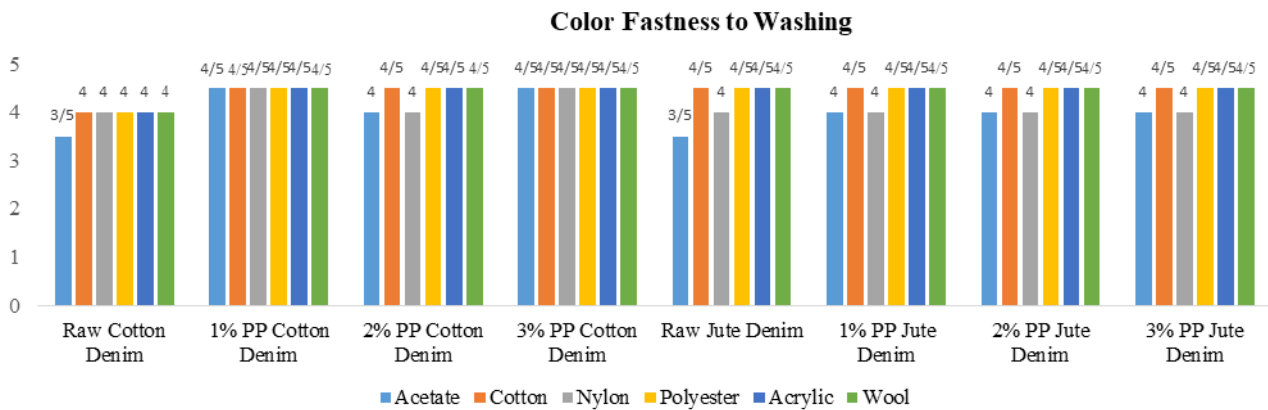


Figure 8: Color fastness (to washing) for Cotton and Jutton Denim

### 3.3.3 Color fastness to water

Color fastness to water test was performed following test procedure ISO-105-E04. It was observed that the fastness

properties were satisfactory.

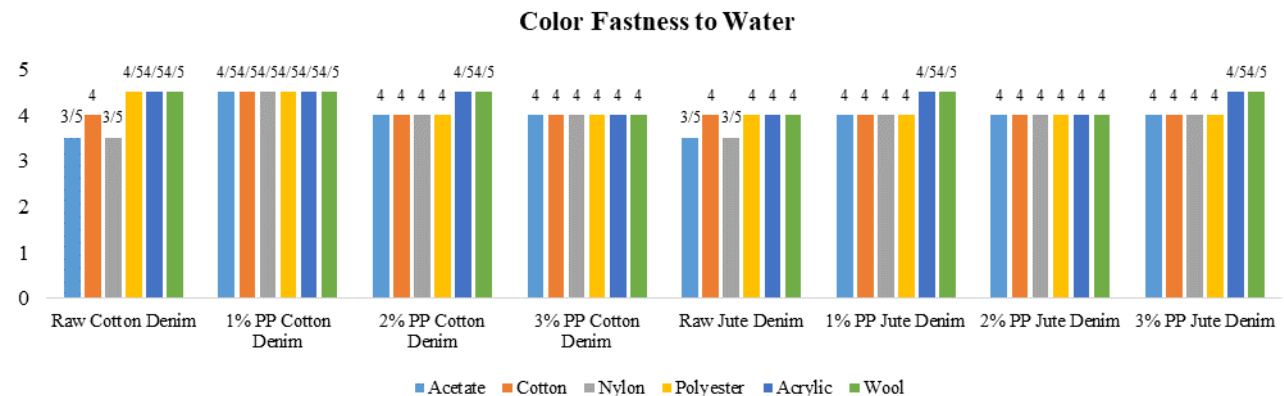


Figure 9: Color fastness (to water) for Cotton and Jutton Denim

### 3.4 Spray rating test:

Spray rating test was conducted following ISO 4920. Where its been observed that Cotton and Jutton showed

the similar rating for varying potassium permanganate solution.

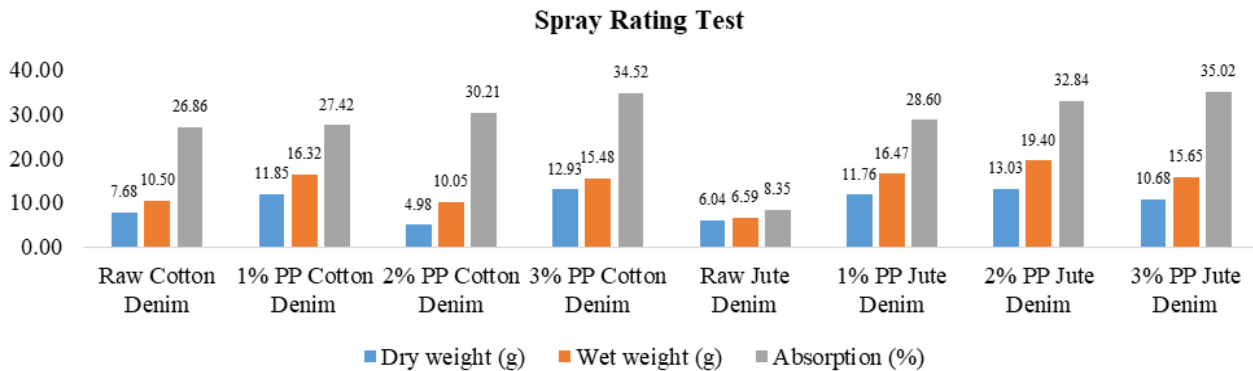


Figure 10: Spray rating test for Cotton and Jutton Denim

### 3.5 Effect of fabric handfeel:

Cotton can impart a better handfeel in comparison with Jutton. The presence of a bit of lignin can be the possible reason for the bit stiffer handfeel.

From the above test results, it is evident that introducing Jutton denim can be a cutting edge solution to keep pace with the upcoming challenges. And for both the aesthetic and functional properties Jute has indeed a better future.

### Challenges to implementation:

The research team believes that the guidance in this study will establish a new possible field of utilizing and promoting Jute as a new form of raw materials in denim

sector. However, there lies scope for further experiments to understand the morphological changes due the chemical processes applied.

### Conclusion:

Present research work examined and characterized physiological standardization and associated quality problems with Cotton-Jute (Jutton) made denim. The aim of this research work was to assess the scientific perceptiveness behind the hypothesis and issues in processing and as well as with the finished denim. So far, for most of the cases, the test results were within the tolerance level. In some instances, Jute acts more like Cotton made denim, so it can be presumed that Jute can be introduced into the current fashion world to open a whole new frontier. Blending Jute with Cotton can surely cut the cost of raw materials as well as increase the versatile uses of Jute. That can surely boost our economy further ahead.

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## NOMENCLATURE

- EPI: Ends per inch  
 PPI: Picks per inch  
 PP: Potassium Permanganate  
 GSM: Gram square per meter