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DEVELOPING EQUATION BETWEEN COUNT AND GSM FOR A PLAIN SINGLE JERSEY FABRIC

Faisal Bin Alam

Assistant Professor, Department of Textile Engineering, BGMEA University of Fashion & Technology (BUFT), Bangladesh, email: faisalbinalam@buft.edu.bd, tareqabc@gmail.com
Corresponding address: BGMEA University of Fashion & Technology (BUFT), S.R.Tower, 105 Uttara Model Town, Sector 7, Dhaka-1230, Bangladesh

ABSTRACT

One of the most common day to day challenges that a knitting industry faces is to determine the appropriate count and stitch length to meet the finished GSM of a fabric. This paper puts an attempt to present an equation for count and GSM for plain single jersey using the value of fabric constant which can surely ease this regular calculation process and can be used as a base to develop new software for industrial application.

Keywords: GSM, Yarn Count, Stitch length, fabric constant, plain single jersey.

INTRODUCTION

GSM of a fabric is a prime quality parameter and that a manufacture has to strictly comply to make the product accepted by the buyer. Grey fabric manufacturing units put a huge attention to produce the fabric in a way that will satisfy the required GSM after finishing. Usually the industries of Bangladesh has been successful in maximum cases so far in managing this basic task through following a GSM chart on the basis of their previous experience. But the problem arises when an order arrives with exceptional GSM which is beyond experience.

This paper aims to develop an equation on count and GSM which can facilitate a great deal to determine the right count to produce a plain single jersey fabric in a knitting industry.

LITERATURE REVIEW

Knit fabrics are produced through the intermeshing of loops (Shah, 2003; Saufley, 1992). Specification of a circular knit fabric includes loop density, loop length, weight per square meter and fabric width (Bourah 2004). A property like GSM for a knit fabric is very difficult to predict before they are produced or gone through a wet process treatment (Reza and Ziko, 2015). Stitch length and fabric weight have shown one of the influential dimensional parameters for weft knitted cotton fabrics by Singh et al (2011). Yarn count and stitch length have a direct effect on single jersey knitted fabrics (Hannan et al., 2014).

Conventional theoretical relationship between count & GSM for a basic single jersey fabric is GSM =350.4-6.879Ne which don't suit properly in industrial parameters. This study took an attempt to justify the relationship and reveal a more practical relationship based on industrial experiments.

MATERIALS & METHODS

Sample: Plain single jersey cotton fabric samples from different circular weft knitting industries were used for this experiment.

Measuring Stitch Length: Stitch length his theoretically a single length of yarn which includes one needle loop and adjacent needle coop so neither side of it. In order to determine the stitch length, we count 100 no of Wales or stitch and count its length by hanging the yarn on the stitch counter. There adding was taken in mm.

Measuring Yar Count:

We followed a different way to find out the count of the yarn. At first we unravelled sufficient no yarns from the fabric. Then we measured the total length of the yarn and measured the weight of that no of yarn. From these weights, we found the count of the yarn. The equation we followed is as follow:

$$\text{Count (Ne)} = \frac{n \times l \times 453.6}{wt \times 36 \times 840}$$

Where,

Ne = English count

n = number of yarn in bundle.

l = length of yarn

Wt= weight of yarn.

Measuring GSM: GSM is calculated in weight (gram per square meter). The GSM cutter is the mostly used instrument in the industry & we measured GSM using that. GSM was determined for 10 different fabric samples.

$$\text{GSM} = \frac{Ks \times tex}{stitch\ length\ (mm)}$$,Ks = fabric constant (single jersey)

$$Ks = \frac{stitch\ length\ (mm) \times GSM}{tex}$$

INDUSTRIAL CHART

Table 1: Relation between yarn count, stitch length, finished diameter& finished GSM

Fabric Type	Yarn count	Stitch length(mm)	Color	Diameter ×Gauge	Finished diameter (inch)	Finished GSM
PlainS/j	$18^S/1$	2.94	White	26×24	30	220-230
,,	$20^S/1$	2.98	White	30×24	33.5	200-210
,,	$24^S/1$	2.68	White	30×24	32	175-185
,,	$26^S/1$	2.66	White	30×24	31	160-170
,,	$28^S/1$	2.70	Avg	26×24	25	150-160
,,	$30^S/1$	2.68	Avg	30×24	30	130-140
,,	$34^S/1$	2.40	Avg	26×24	24	125-135
,,	$40^S/1$	2.44	Avg	24×24	20	100-110
,,	$18^S/1$	3.00	Avg	30×24	46	245-255
,,	$24^S/1$	2.64	Avg	30×24	40	210-215
,,	$26^S/1$	2.60	Avg	30×24	36	200-210
,,	$30^S/1$	2.50	Avg	30×24	33	180-190

Industrial practice is if the fabric is to be Enzyme washed, the stitch length should be kept (10%) less than the normal range. For light color, the finished GSM varies1-2% from grey GSM; average color, the finished GSM varies2-4%.

EXPERIMENTAL OUTCOME

Table 2: Constant obtained from collected plain single jersey (Ref-Appendix)

S/N	GSM	SL	COUNT	EQUATION	AVERAGE	STD DVE	CV
1.	160.5	2.699121	30.87	13373.15	12083.96	946.3509	7.831462
2.	122.48	2.664324	37.78	12328.44			
3.	127.03	2.965405	31.63	11914.8			
4.	148	2.610811	28.8	11128.32			
5.	160.22	2.881429	27.12	12131.38			
6.	145.6	3.025213	35.29	15563.68			
7.	153	2.701087	30	12397.99			
8.	163.715	2.880883	26.97	12720.23			
9.	141.4	3.047012	32.14	13847.38			
10	135.78	2.319347	32.92	10366.43			

$$\text{Deflection} = \frac{12083.96 - 12047.625}{12047.625} \times 100$$
$$= 0.3\%$$

Actual determination of fabric GSM and yarn count from the collected fabric:

S/N	COUNT	G.S.M
01.	30.87	172.33
02.	37.77	121.33
03.	31.63	139.33
04.	28.8	142.63
05.	27.12	176.67
06.	35.29	154.33
07.	29.99	165.33
08.	26.97	168.33
09.	32.13	134.33
10.	32.92	139.33

Graph**:**

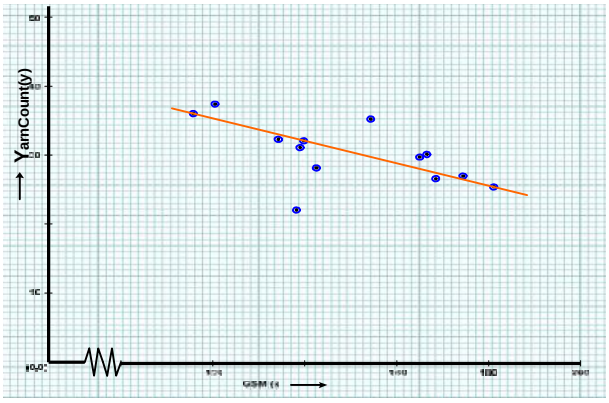

Fig: Relation between yarn count (Ne) & GSM

By taking two points from the straight line, we can find the following equations:

X = 332-5.88 y

Y = 56 – 0.17 x

RESULT

The revised constant for the plain single jersey is as follow:
K (Yarn count X stitch length X GSM)=12083.96
Relation between the fabric GSM and the yarn count: If the GSM of the fabric is “x” and the count of yarn is “y”, then thee quation for determining GSM and the Yarn count is as follows:

GSM, x=332 –5.88y

Yarn count (Ne),y=56 –0.17x

CONCLUSION

Limitation of this study is that it has been able to develop industry oriented count-GSM relationship only for plain single jersey cotton fabric as it demands huge time and data. But surely this research opens the door for further analytical research on the actual count-GSM relationships for different types of fabrics, fabric width calculation, machine selection criteria and so on.

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Short Bio:

Faisal Bin Alam is an assistant professor at the BGMEA University of Fashion & Technology in Dhaka, Bangladesh. He is a professional from textile background and involved in textile consultancy. He is research team leader of different multinational projects like NICHE. He is also an expert adviser on Compliance, CSR & Sustainability.

Appendix

S/L NO	SAMPLE NO	CPI				WPI				STITCH LENGTH				COUNT						GSM		CACULATED GSM	DEFLECTION% OF ACTUAL GSM FROM CALCULATED GSM
		LENGTH OF FABRIC	NO.OF COURSE	CPI	AVG CPI	LENGTH OF FABRIC	NO. OF WALES	WPI	AVG WPI	LENGTH OF YARN	NO OF WALES	S.L	AVG S.L	LENGTH OF EACH YARN	NO OF YARN	TOTAL LENGTH	TOTAL WEIGHT	COUNT	AVG COUNT	GSM	AVG GSM		
	unit	inch	unit	unit	unit	inch	unit	unit	unit	mm	unit	mm	mm	inch	unit	unit	gm	Ne	Ne	gm	gm	gm	%
1	01	1	53	53	53.1	1	289	34	34	775	289	2.682	2.699	27	10	270	0.14	28.93	30.87	170	172.33	160.5	7.3%
2			54	54			289	34		785	289	2.716											
3			52	52			289	34		785	289	2.716											
4			54	54			289	34		775	289	2.682								175			
5			53	53			289	34		775	289	2.682											
6			53	53			289	34		775	289	2.682		35	10	350	0.16	32.81					
7			54	54			289	34		785	289	2.716											
8			52	52			289	34		785	289	2.716								172			
9			53	53			289	34		775	289	2.682											
10			53	53			289	34		785	289	2.716											
1	02	1	52	52	50.9	1	372	37	37	988	372	2.656	2.664	34	20	680	0.27	37.78	37.78	120	121.33	122.48	0.945%
2			50	50			376	38		1010	376	2.686											
3			50	50			373	37		991	373	2.657											
4			51	51			372	37		988	372	2.656								127			
5			51	51			373	37		991	373	2.657											
6			52	52			372	37		991	372	2.664											
7			51	51			372	37		996	372	2.677											
8			50	50			373	37		991	373	2.657								117			
9			52	52			372	37		993	372	2.669											
10			50	50			372	37		991	372	2.664											

SL NO	SAMPLE NO	CPI				WPI				STITCH LENGTH				COUNT						GSM		CALCULATED GSM	DEFLECTION OF ACTUAL GSM FROM CALCULATED GSM
		LENGTH OF FABRIC	NO. OF COURSE	CPI	AVG CPI	LENGTH OF FABRIC	NO.OF WALES	WPI	AVG WPI	LENGTH OF YARN	NO OF WALES	S.L	AVG S.L	LENGTH OF EACH YARN	NO OF YARN	TOTAL LENGTH	TOTAL WEIGHT	COUNT	AVG COUNT	GSM	AVG GSM		
	unit	inch	unit	unit	unit	inch	unit	unit	unit	mm	unit	mm	mm	inch	unit	unit	gm	Ne	Ne	gm	gm	gm	%
1	03	1	43	43	40	1	370	37	37	1100	370	2.973	2.965	24	18	432	0.2	32.4	31.63	139	139.33	127.03	9.68%
2			40	40			370	37		1105	370	2.986											
3			40	40			370	37		1100	370	2.973											
4			40	40			370	37		1095	370	2.959											
5			39	39			370	37		1097	370	2.965											
6			40	40			370	37		1095	370	2.959								140			
7			40	40			370	37		1095	370	2.959											
8			39	39			370	37		1093	370	2.954		24	18	432	0.21	30.86					
9			40	40			370	37		1097	370	2.965								139			
10			39	39			370	37		1095	370	2.959											
1	04	1	48	48	48.2	1	185	37	37	483	185	2.611	2.611	12	16	192	0.1	28.8	28.8	144	142.67	148	4.05%
2			49	49			185	37		485	185	2.622											
3			49	49			185	37		485	185	2.622											
4			49	49			185	37		486	185	2.627											
5			48	48			185	37		485	185	2.622								142			
6			47	47			185	37		484	185	2.616											
7			48	48			185	37		480	185	2.595											
8			49	49			185	37		480	185	2.595		12	16	192	0.1	28.8					
9			47	47			185	37		480	185	2.595								142			
10			48	48			185	37		482	185	2.605											

SL NO	SAMPLE NO	CPI				WPI				STITCH LENGTH				COUNT						GSM		CACULATED GSM	DEFLECTION % OF ACTUAL GSM FROM CALCULATED GSM
		LENGTH OF FABRIC	NO. OF COURSE	CPI	AVG CPI	LENGTH OF FABRIC	NO. OF WALES	WPI	AVG WPI	LENGTH OF YARN	NO OF WALES	S.L	AVG S.L	LENGTH OF EACH YARN	NO OF YARN	TOTAL LENGTH	TOTAL WEIGHT	COUNT	AVG COUNT	GSM	AVG GSM		
	unit	inch	unit	unit	unit	inch	unit	unit	unit	mm	unit	mm	mm	inch	unit	unit	gm	Ne	Ne	gm	gm	gm	%
1	05	1	46	46	45.6	1	350	35	35	1012	350	2.891	2.699	29	19	551	0.32	25.83	27.12	176	176.67	160.2	10.2%
2			45	45			350	35		1010	350	2.886											
3			48	48			350	35		1008	350	2.88											
4			44	44			350	35		1008	350	2.88								176			
5			46	46			350	35		1008	350	2.88											
6			45	45			350	35		1000	350	2.857		36	20	720	0.38	28.42					
7			46	46			350	35		1006	350	2.874											
8			45	45			350	35		1010	350	2.886								177			
9			45	45			350	35		1015	350	2.9											
10			46	46			350	35		1008	350	2.88											
1	06	1	47	47	47.1	1	367	37	37	1110	367	3.025	3.025	40	20	800	0.34	35.29	35.29	153	154.33	145.6	6.10%
2			47	47			367	37		1110	367	3.025											
3			46	46			367	37		1110	367	3.025											
4			47	47			367	37		1110	367	3.025								155			
5			48	48			367	37		1110	367	3.025											
6			47	47			367	37		1110	367	3.025											
7			48	48			367	37		1110	367	3.025											
8			47	47			367	37		1110	367	3.025								155			
9			47	47			367	37		1110	367	3.025											
10			47	47			367	37		1110	367	3.025											

SL NO	SAMPLE NO	CPI				WPI				STITCH LENGTH				COUNT						GSM		CACULATED GSM	DEFLECTION % OF ACTUAL GSM FROM CALCULATED GSM
		LENGTH OF FABRIC	NO. OF COURSE	CPI	AVG CPI	LENGTH OF FABRIC	NO. OF WALES	WPI	AVG WPI	LENGTH OF YARN	NO OF WALES	S.L	AVG S.L	LENGTH OF EACH YARN	NO OF YARN	TOTAL LENGTH	TOTAL WEIGHT	COUNT	AVG COUNT	GSM	AVG GSM		
	unit	inch	unit	unit	unit	inch	unit	unit	unit	mm	unit	mm	mm	inch	unit	unit	gm	Ne	Ne	gm	gm	gm	%
1	07	1	51	51	51	1	368	37	37	995	368	2.704	2.701	36	20	720	0.36	30	30	166	165.33	153	8%
2			51	51			368	37		994	368	2.701											
3			51	51			368	37		995	368	2.704											
4			51	51			368	37		995	368	2.704								165			
5			51	51			368	37		992	368	2.696											
6			51	51			368	37		993	368	2.704											
7			51	51			368	37		994	368	2.698											
8			51	51			368	37		995	368	2.701		36	20	720	0.36	30					
9			51	51			368	37		994	368	2.704								165			
10			51	51			368	37		993	368	2.698											
1	08	1	46	46	46.4	1	182	36	36	523	182	2.874	2.881	40	12	480	0.27	26.67	26.97	168	168.33	161.7	2.82%
2			47	47			180	36		518	180	2.878											
3			47	47			183	37		525	183	2.869											
4			46	46			182	36		524	182	2.879								169			
5			47	47			181	36		520	181	2.873											
6			46	46			179	36		520	179	2.905		40	10	400	0.22	27.27					
7			46	46			178	36		515	178	2.893											
8			47	47			179	36		516	179	2.883											
9			46	46			180	36		518	180	2.878								168			
10			46	46			180	36		518	180	2.878											

SL NO	SAMPLE NO	CPI				WPI				STITCH LENGTH				COUNT						GSM		CALCULATED GSM	DEFLECTION % OF ACTUAL GSM FROM CALCULATED GSM
		LENGTH OF FABRIC	NO. OF COURSE	CPI	AVG CPI	LENGTH OF FABRIC	NO. OF WALES	WPI	AVG WPI	LENGTH OF YARN	NO OF WALES	S.L	AVG S.L	LENGTH OF EACH YARN	NO OF YARN	TOTAL LENGTH	TOTAL WEIGHT	COUNT	AVG COUNT	GSM	AVG GSM		
	unit	inch	unit	unit	unit	inch	unit	unit	unit	mm	unit	mm	mm	inch	unit	unit	gm	Ne	Ne	gm	gm	gm	%
1	09	1	43	43	42.7	1	383	38	38	1166	383	3.044	3.047	20	16	324	0.15	32.4	32.14	135	134.33	141.4	4.97%
2			42	42			379	38		1155	379	3.047											
3			43	43			384	38		1170	384	3.047											
4			44	44			379	38		1155	379	3.047								133			
5			43	43			383	38		1167	383	3.047											
6			42	42			380	38		1158	380	3.047		43	10	425	0.2	31.87					
7			43	43			380	38		1158	380	3.047											
8			42	42			383	38		1167	383	3.047											
9			43	43			379	38		1155	379	3.047								135			
10			42	42			384	38		1170	384	3.047											
1	10	1	51	51	52.5	1	398	40	40	927	398	2.329	2.319	35	10	345	0.16	32.34	32.92	140	139.33	135.8	2.62%
2			53	53			398	40		927	398	2.329											
3			53	53			398	40		915	398	2.299											
4			52	52			398	40		915	398	2.299											
5			53	53			398	40		915	398	2.299								140			
6			53	53			398	40		921	398	2.314		34	10	335	0.15	33.5					
7			52	52			398	40		935	398	2.349											
8			53	53			398	40		921	398	2.314											
9			52	52			398	40		915	398	2.299								138			
10			53	53			398	40		940	398	2.362											