COMPARATIVE ASSESSMENT AND FEASIBILITY ANALYSIS OF NATURAL DYE SOURCES FOR COMMERCIAL APPLICATION

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Abstract

Natural dyes extracted from plants are potential renewable sources which can be applied for dyeing of wool, silk and cotton. But due to non-availability of sufficient natural dyes sources, repeatability and cost the use of natural dyes for commercial dyeing application has declined considerably. But by correctly identifying the natural dye sources, the natural dye can be utilized by industries on a commercial scale. For the identification of the potential dye sources, a quantification technique has been generated. Based on the quantification technique the identified potential dye sources can be evaluated for commercial suitability. Two potential natural dyes were used as source of colour extraction. Dyeing of cotton fabric with natural colorant has been done. The dyeing process was carried out with different mordant. Wash fastness of dyed sample has been evaluated. The wash fastness, time estimation and water required were compared among the two natural dyes sources and it is prioritized for commercial application.

Keywords: - Natural Dyes, Mordant, Wash Fastness, Time and Water estimation, Commercial scale

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1. INTRODUCTION

Textile materials are coloured for value addition, looks and fulfilling the desires of the customers. Anciently, this purpose of colouring textile was initiated using natural sources, until synthetic dyes were invented. Almost all the synthetic dyes are made from petrochemical sources through hazardous chemical processes and pose threat to the environment. However, worldwide environment protection and safety renewed the interest of the people on natural products like natural fibres and natural dyes. The natural dye is not commercially used in the industry as it has limitations such as poor color fastness, practical difficulty in repeatability, seasonability and high cost (Ashis Kumar Samanta and Adwaita Konar 2011).

In this paper, based on the literature survey the identified potential dye sources Marigold and Onion peel are evaluated for commercial suitability. The selection of potential natural dye source is done based on the quantification technique, which involves variable parameters which influence the dyeing process. The cotton fabric has been chosen for dyeing. The various parametrs that should be taken into account are

- Availability of dye material round the year.
- Time needed to grow the plant material or to yield the dye
- Colour yield
- Dye concentration needed
- Wash fastness
- Light fastness
- Rub fastness
- Fastness to perspiration
- Dye bath temperature
- Dyeing time

- Need for mordant and its concentration
- Waste generated
- Quantity of liquid effluent
- Material cost
- Processing cost
- Use of the dye source for other application

2. DESIGN OF EVALUATION METHOD

For identification and selection of the potential dye sources, a commercial dyeability index has been generated. This commercial dyeability is based on the variable parameters which influence the dyeing process. The parameters are fastness property, K/S value, extraction temperature, extraction and dyeing time, hazard factor, hazardous materials, availability of plant source, seasonability, wastewater, solid and liquid waste, cost factor and the application factor. The values to be assigned for the evaluation are tabulated in the table 1 to table 8.

Commercial Dyeability Index

The generated commercial dyeability index is:

Commercial dye ability index =

{[Source factor + 3* (Fastness + Colour Yield)] / [Dyeing Factor +Hazard Factor + cost factor]} + Application factor

Where,

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Source factor	=	[Availability + Time for the Plant to grow]
Fastness	=	[2[Wash fastness]+light
		Fastness + Rub fastness
		+ perspiration fastness]
K/s	=	[Color yield]
dyeing factor	=	[Dyeing temperature +
		Dyeing time + mordant
		Concentration + dye content]
Hazard factor	=	[Toxicity + solid waste
		Generated+ liquid waste
		generated]
Cost factor	=	[Material cost + processing
		Cost]
Application	=	[Use of dye source in other
factor		useful application]
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First the commercial dyeability index is calculated for selected dye source and then its value is used to look up in the commercial dyeability index value given in Table 1. The larger the value the commercial dyeability index, the more suitable it becomes for commercial application.

Table	1:	Availability
I able		<i>i</i> wanability

Availability	Once in months	4	Once in months	6	Once in 12 months
Value	3		2		1

Table 2	:Time	for the	Plant to	grow
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Time for the	1 year	6 months	4 months
Plant to			
grow			
Value	1	2	3

Table 3: Fastness	property
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Fastness	Less than 3	3-4	4-5
property			
value	1	2	3

Dyeing temperature	40-50 ⁰ C	50- 70 ⁰ C	Above 70 ⁰ C
value	3	2	1

Table 4: Dyeing temperature

Table 5: Dyeing time

Dyeing time	Less than 30 minutes	30-45 minutes	Above 45 minutes
value	3	2	1

Table 6: Hazard factor					
Hazard factor	Presence of toxic waste, solid waste and liquid effluent	No toxic waste	Only liquid effluent		
value	3	2	1		

Table 7 : Cost factor

Cost factor	Less costly	Medium	Considerable		
			cost		
value	1	2	3		

Table 8: Application factor

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Application	Can be used	Only used	Only suitable
factor	for Textile,	for	for for
	food and	Textile and ,	Textile
	cosmetic	cosmetic	applications
	applications	applications	
value	1	2	3

Table 9: Commercial Dyeability Index Value

Commer cial Dyeabili ty Index	Not Applicable For Commercial Application	Can Be Considered	Suitable For Commercial Application
Value	below 2	2-4	Above 4

3. PRETREATMENT OF FABRIC

The experiments were conducted for dye extraction, dyeing and wash fastness properties using literature support. Desizing is done in order to remove the size from the warp yarns of the woven fabrics. It is done by soaking the cotton fabric in 0.5% of concentrated Sulphuric acid in 1:20 liquor ratio for 12 hour. (Kulkarni S.S, Gokhale A.V, Bodake U.M, Pathade G.R, 2011).

Scouring is done to remove dirt, wax and oil. The scouring is done by dipping the fabric in a distilled water (1:20) containing the mixture, Sodium hydroxide (5%), Sodium carbonate (1%), and Soap oil (1%) and kept at 100°C for 4 hour. (Kulkarni S.S, Gokhale A.V, Bodake U.M, Pathade G.R, 2011).

4. DYEING WITH MARIGOLD

Marigold is annual plant and perennial plant, mostly herbaceous plant in the sunflower family Asteraceae. It bears yellowish orange flowers in abundance during the flowering season which lasts for more then 6-8 months.

For dye extraction, the Marigold petals were dried in shade and powdered. The powdered flowers petals of Marigold (50 g) was dissolved in 500 ml of distilled water and heated for https://doi.org/10.15623/ijret.2018.0705009

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100°C one hour at (Padma.S Vankar. Rakhi Shankar, Samudrika, 2009). The extract was filtered to obtain a vellowish brown dve solution.

For mordanting, accurately weighed cotton samples were pre-mordanted with Alum and Copper Sulphate. The mordant 2% (owf) was dissolved in water to make a liquor ratio 1:40 and heated at 80°C for a period of 1 hour (Padma.S Vankar, Rakhi Shankar, Samudrika, 2009).

Then the pre-treated samples are immersed in dye bath for 1 hour at a temperature range of 70- 80 °C, keeping M: L ratio as 1:50 (Padma.S Vankar, Rakhi Shankar, Samudrika, 2009).

5. DYEING WITH ONION PEEL

The onion is used as a vegetable and is most frequently a biennial plant or a perennial plant. But the skin of the onion which is inedible can be used as dyes.

For dye extraction, the unused onion peel was collected and 30 g of onion peel was dried in shade and powdered. The outer most onion scales which was powdered (20 g) was boiled in 1 litre of distilled water for 1 hour. (Ferial M. Tera, Khaled E. Elnagar, S.M Mohamed, 2012). Then it was filtered to obtain a reddish brown dye solution.

For pre-mordanting, the fabric was pre- mordanted by soaking separately for 12 hours in (5g/L) for Alum and (1.6g/L) for Potassium dichromate. And the post mordanting was carried out separately in a solution of Copper sulphate of (1.2 g/L) and (1.6 g/L) for Ferrous sulphate in distilled water, the dyed fabric was immersed in the solution of liquor ratio (LR) (1:50), then temperature was raised to 80°C and kept for 1 hour. (Ferial M.Tera, Khaled E.Elnagar, S.M Mohamed, 2012).

The pre-treated samples are immersed in dye bath containing extracted solution of natural dye for 1 hour at a temperature range of 80°C, keeping M: L ratio as 1:40 (Ferial M.Tera, Khaled E. Elnagar, S.M Mohamed, 2012).

6. WASH FASTNESS

The wash fastness is the ability of fabrics to retain the dyes used to color them, when subjected to washing. Preparation of soap solution is done by dissolving 0.2 g of soap powder into 20 ml of water. Place the dyed fabrics in solution mixture and keeps it for 2 minutes. Then the sample is dried and checked for color change. The number of wash is continued still no color is detected in the water during washing.

7. PROCESSING TIME AND WATER

ESTIMATION

The time required for each process involved during dyeing for each natural dye source is 5 hours and 10 minutes. The

total water required in the each phase of the dyeing process is estimated and it was found to be ranging from 1000- 4000 ml of water.

The wash fastness, time estimation and water required were compared among the two natural dyes sources and it is prioritized. The prioritized potential dye sources are listed in the order in the table 10.

Table 10: Priortised dye sources			
S.No	Dye Source	Mordant Used	
1	Onion	Alum	
2	Onion	Copper sulphate	
3	Onion	Potassium di chromate	
4	Onion	Ferrous sulphate	
5	Marigold	Copper sulphate	
9	Marigold	Alum	

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8. RESULT AND DISCUSSION

The identified potential natural dye sources namely, Onion peel, and Marigold have been selected and dyeing process have been done.

Dyed fabric are subjected to wash fastness test, and it can be observed that onion dyed fabric stops fading after the second wash, whereas for Marigold, color either fades or the color bleeds in the water at third wash or after third wash. So the cloth dyed with Onion peel was found to have better fastness than Marigold.

The color shades obtained are more soothing and uniform for the fabric dyed with Onion peel and Marigold. In case of time and water required, all the two natural dyes have equal expenditure for time and water required. Based on the commercial dyeability index, wash fastness, cost and time estimation the dye sources with different mordants have been prioritized, which is shown in table 10. And Onion peels as natural dye source has showed good result and it is found to be suitable for large scale application.

9. CONCLUSION

In this paper, commercial dyeability index for selection of natural dyes for commercial application has been evolved. A comparison of potential dye sources for commercial application has been done. Based on the commercial dveability index, wash fastness, cost and time estimation the dye sources with different mordants can be prioritized and used for commercial application with good success.

REFERENCES

- [1] Ferial M.Tera, Khaled E. Elnagar, S. M. Mohamed, Journal of textile and apparel, technology and management, Volume 7, Issue 3, Spring2012.
- [2] Kulkarni S.S, Gokhale A.V, Bodake U.M, Pathade G.R., Universal Journal of Environmental Research and Technology, Volume1, Issue 2: 135-139, (2007).

https://doi.org/10.15623/ijret.2018.0705009

- [3] Padma.S Vankar, Rakhi Shankar, Samudrika, Journal of textile and apparel, technology and management, Volume 6, Issue 1, Spring2009.
- [4] Dr.PadmaS.Vankar, Handbook On Natural Dyes For Industrial Applications, 2007.
- [5] Ashis Kumar Samanta and Adwaita Konar, inTech2011, DOI: 10.5772/21341. Available from: https://www.intechopen.com/books/naturaldyes/dyeing-of-textiles-with-natural-dyes.