University of Mauritius

SUMMARY OF FINDINGS INTO ENERGY SAVINGS PROVIDED BY METALTEC TC ON DYEING MACHINES AT FERNEY SPINNING MILLS

Background: MetalTec TC, a groundbreaking liquid insulation thermal coating, was used at Ferney Spinning Mills to protect personnel from burns and provide energy savings on dyeing machines. Both Ferney Spinning Mills and Metaltec Representatives wanted to measure the energy savings following application. The University of Mauritius accepted to study and measure the energy savings in an independent and scientific manner as part of their ongoing research projects into energy savings.

Product application:

MetalTec TC clearly states that for temperatures up to 110°C, the coating fitness should be between 1.4 to 2.8 mm. Following a first inspection, representatives from MetalTec TC stated that no primer would be required for the insulation of dyeing machines. MetalTec TC was mixed using a mud paddle for ten minutes without any addition of water before being applied to the surface using spray gun. During application of the product, the machines were heated to facilitate curing. Five separate layers of MetalTec TC were applied to the surface to reach an overall thickness of 2.4 mm. After application of each layer, it was left to cure for 3 to 4 hours with the machine being heated to a temperature of $75°C$. In total, 60L of Metaltec TC was required for the thermal coating of machine 7001. The application of the first coat and the result after application of 2.4

mm coating is shown in figures 6.2 and 6.3 respectively.
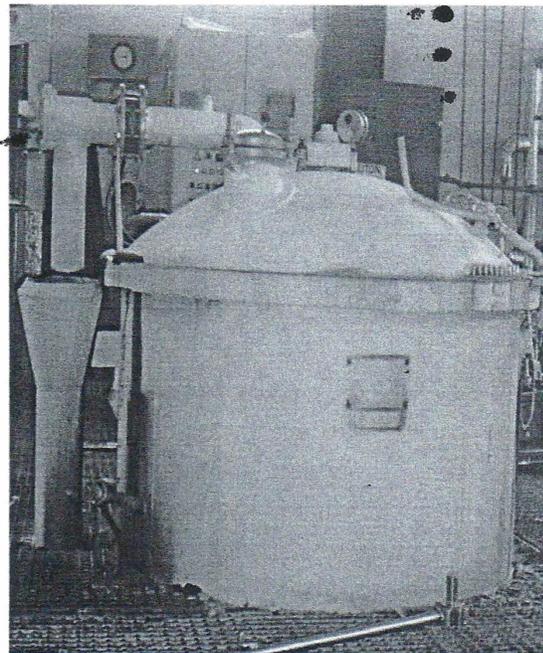

FIGURE 6.2: APPLICATION OF FIRST COAT

FIGURE 6.3: AFTER APPLICATION OF 2.4mm Metaltec TC

Expected outcome:

The additional 2.4mm coating on the surface of the machine will have a decreasing effect on the heat transfer coefficient. The new heat transfer co efficient is calculated using the following equation:

$$\frac{1}{U} = \frac{1}{ha} + \frac{x}{k} + \frac{1}{hb}$$

Since the heat transfer coefficient of Machine 7001 had already been calculated at 15.76 W / m2 K, the new heat transfer coefficient is calculated as follows:

$$\frac{1}{U\ new} = \frac{1}{U\ old} + \frac{x}{k}$$

$$\frac{1}{Um} = \frac{1}{15.76 \times 10^3} + \frac{0.0024}{0.097}$$

Results after Insulation:

In order to calculate the new efficiency of Machine 7001, the same set of three tests were done and the results are summarized in the below table:

	ENERGY DELIVERED - GJ	ENERGY USEFUL - GJ	EFFICIENCY
TEST 1	4.47	3.71	82.9 %
TEST 2	4.68	3.87	82.8 %
TEST 3	4.55	3.84	84.4 %
		AVERAGE	82.3 %

After thermal insulation with MetalTec TC, the new calculated efficiency for dyeing is 82.3%. This improved efficiency is due to lower steam consumption mainly during the heating processes. This is explained by the fact that less energy is being lost as the machine has a new heat transfer coefficient. The surface temperature during the holding time was monitored and the following results were obtained:

Surface Temperature after insulation:

Process	Surface Temp 1	Surface Temp 2	Surface Temp 3	Mean Surface Temp	Temp Difference
Hold at 95°C	64.3	64.4	64.3	64.3	30.7
Hold at 80°C	62.0	61.6	61.8	61.8	18.2
Hold at 70°C	52.6	52.9	52.8	52.8	17.2
Hold at 60°C	45.0	45.0	45.1	45.0	15.0
Hold at 50°C	39.4	39.5	39.5	39.5	10.5
				Mean	18.3

All temperatures expressed in °C.

It can be noted that the surface temperature has been lowered from 76.4°C to 64.3°C when holding the dye bath at a temperature of 95°C. This represents a decrease of 15.8% of surface temperature at raised temperatures. However it can be noted that the surface temperature does not decrease by the same extent for holding temperatures from 80°C to 50°C.

Cost Analysis:

With the new improved dyeing efficiency of 82.3%, steam consumption will decrease, as less heat will be required for heating. With a dyeing efficiency of 77.3%, FSM dye house uses on average 4.24 kg steam to dye 1 kg of fiber.

Efficiency = Useful energy / Energy supplied x 100

At 77.3% efficiency the useful energy that was obtained from 4.30 kg of steam is:

Energy supplied by 4.24 kg steam = (4.24 x 2.39) = 10.14 MJ

Useful energy obtained from 10.29 MJ = 10.14 x (77.3/1 00) =7.84 MJ

At an efficiency of 82.3%, the amount of energy required to obtain 7.95 MJ of useful energy is calculated by:

Amount of energy to be supplied = 7.84 x (100/82.3) = 9.52 MJ

This energy can be supplied by 3.98 kg of steam, meaning that the new steam to dye fiber ratio will be 3.98. This represents a decrease of 0.26kg (6.13%) in steam consumption, which will result in a savings of Rs0.47per kg of dyeing. The mean monthly consumption also will decrease to 378.76 tones and this will be the baseline for steam consumption under ECM 1.

However to achieve this new ratio the remaining 12 dyeing machines also need to be coated. The cost for the thermal coating done on Machine 7001 is Rs 82,800.00 inclusive of VAT and labour Rs 4,600.00 per SQM. The total exposed surface area for a machine in FSM dye house is 124 SQM and the investment for 124 SQM of MetalTec TC thermal insulation is Rs 570,860.00.

Since the production of the dye house does not have a linear variation, explained by peak and low seasons, the mean of annual production for the five last years is taken to calculate the payback period. The total annual production of FSM dye house for the past five years is shown in the below table the mean is calculated as 1327.4 tones.

YEAR	ANNUAL PRODUCTION (TONE)
2009	1452
2010	1325
2011	1437
2012	1117
2013	1306
MEAN	**1327.4**

Conclusion:

With a dyeing efficiency of 82.3%, FSM dye house will be able to make a saving of Rs 617,771.00 annually meaning that the investment in Metaltec TC insulation will be recovered over 11 months and financial benefits of ECM 1 will be harvested from the 12th month following application of MetalTec TC.

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