MODELING OF CLAY ROOF TILES DRYING PROCESS TO MINIMIZE WARPING AND CRACKING

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DECLA RATION

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My journey of becoming a Masters has finally culminated. It was't an easy task through the untiring support of my wife and family, finally I have done it.

Abstract

The main drawback of traditional open rack type natural tile drying process is that in low humid windy seasons the rate of moisture removal will be high and due to formation of high moisture content gradient in side the tile warping/cracking is taking place. On the other hand in high humid rainy season the drying rate becomes very low and the drying time will become very high which is non tollarable within the tile production process.

With this background NERDC is in the process of developing a tunneltype drier in which the temperature and RH could be controlled. Then the intention is to control these parameters in side the drier so as to maintain the optimum drying condition i.e the maximum drying rate without warping/cracking. To achieve this objective a model has to be developed to interpret the drying rate related to R.H and Temperature of the drying environment and the moisture content of the tile. Once this model is developed and if the maximum allowable drying rate for not warping/cracking is known RH, Temperature in side the dryer could be maintained to achieve the maximum drying rate.

Although a literature survey was done a proper model for clay roof tile drying was not found. So, mathematical model with a few unknown constants was developed by using fundamental concepts. Subsequently laboratory tests were conducted to find out the unknown constants of the developed mathematical model.

The model was verified by using the results obtained at the tile drier (tunel) developed by NERDC at Waikkala . These tests were carried by maintaining R.H and Temperature in side the drier for which warping/cracking was not observed. Therefore by using these results although the model was verified the optimum drying conditions cannot be interpreted. For that interpretation maximum possible drying rates for particular moisture contents of the tile has to be foundout by a separate experiment.

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Aim

To find out the optimum drying temperature and relative humidity of the dryer which leads to minimizing of warping effect.

Objective

1. To study the mechanism of warping & cracking in relation to drying rate.
2. Development of a methamatical model for drying rate of tiles.

Methodology

1. By literature survey and basic knowledge interpreting the mechanism of warping, cracking, in the tile drying process.
2. Carrying out drying tests in the laboratory and development of the drying model
3. Veryfying the model by using the test results from Waikkala drier.

Nomenclature

Ko – Arbiter constant

K1 – Constant

M – Weight of the tile

$\dot{M}$ – Rate of moisture removal

RH – Realtive humidity

Vp – Vapor pressure at particular RH and Temperature

1.INTRODUCTION

Clay roof tiles dominate in the market as they are elegant and are made of standard roofing material at certain times in history and today, face some setback due to the competition from cheaper alternative roofing materials. Yet the traditional clay roof tile draws a

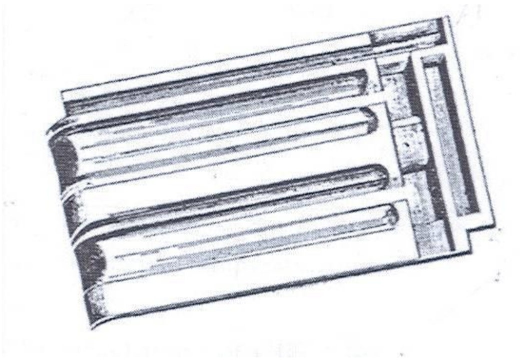


Figure 1: Clay tile

special interest as a roofing material due to its aesthetic character and better thermal comfort it provides. Clay is a very basic naturally available material and its recyclability would be quite faster and easier compared to asbestos roofing which is carcinogenic. Also, the used clay roof tile can be reused as well. Considering the environment and sustainability, clay roof tile can be considered as a long lasting option as a roofing solution. However, the market share of these tiles is only10-15% in Sri Lanka as there are several imported roofing materials. Earlier the main clay tile profile type was Calicut but now profiles come in various shapes. In Sri Lanka there are about 290 numbers of small scale tile factories, having monthly capacity less than 150,000 tiles while only 5 numbers of large scale factories in operation with monthly capacity more than 150,000 tiles.

The quality of clay tiles are governed by the Sri Lanka Roofing Tile standards (SLS2:2016). The standard covers Calicut, Roman, Euro, Spanish, Plain and Sinhala roofing tiles. In addition, SLS2:2016 extends to cover the European export tile requirements. Drying is the most critical stage as long as quality is concerned. Improper drying causes tile to be deformed. The traditional practice is to allow the tiles to lose its surface moisture content in ambient conditions by stacking them in open racks. On average, rate of deformed products (rejects) is 20% and the drying time is around 8 days. But in dry, drying is faster, but causes more than 50% rejects due to deformation. During the rainy season drying takes prolonged periods extending to about 2 weeks. The warping and cracking issue is critical in low humid windy periods. In such periods surface moisture removal rate will be high. In rainy periods the temperature will be low and humidity will be high and therefore drying rate is very low and virtually warping/cracking will not take place. But in these periods the issue is the long drying time. The improvements in industry to adapt wider range of clay types as raw material and improving productivity including product quality would make the clay roof tile industry much attractive. Technology based interventions are necessary for such approaches and the drying process associated with traditional roof tile manufacturing process need an immediate attention. For such situation a close drying space where temperature and air intake /exhaust could be controlled to a certain degree to provide a viable solution. Objective of the study is to develop drying characteristics model for tiles after the removal of free surface moisture. During the literature survey (as stated before) it was revealed that warping critically depends on “rate of drying”. Therefore if the rate of drying could be maintained at the maximum value which will not include warping, it will provide the minimum drying time. Then with few experimental trials it is possible to findout the maximum drying rate possible without warping. Then by using the model it will be possible to achieve that drying rate with suitable RH and temperature values.

1.1 Warping and cracking in drying

In the drying process warping will take place in materials which shrinks with the reduction of moisture. Shape and degree of warping will depend on the variation of moisture content within the material and the shape of the object. In warping materials with elastic properties will develop internal stresses and therefore crack may form. Variation of microstructure within the material will take place due to fast drying (Surface moisture removal) specially when hydraulic conductivity is low and/or uneven drying through different surface of the same object. In the tile drying process in open racks at Waikkala tiles tends to warp. This may be due to different surface moisture removal rates from top and bottom surface and/or shape of the tile. Crack (pattern) could be identified as due to the stresses (tensile) which have developed due to this warping shape.

1.2 Three phases of tile drying

In a first drying phase evaporation take place at the surface. (Surface moisture or free moisture) Capillaries and pores are filled with water and individual solid items are enveloped in a moisture film. As the pore water and a moisture film evaporate an additional moisture component is conveyed to the surface from the interior of the ware. As the rate of evaporation at the surface continually exceeds the amount of moisture replacement from the interior of the ware, the evaporation front is displaced and recedes towards the interior.

Then the so called second drying phase begins and the drying rate falls. In this phase the phenomena, described before are supplemented by two additional processes:

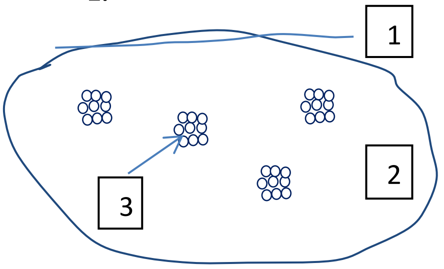
a) Conduction of part of heat transferred from the air to the green ware surface to the interior of the product.
b) Diffusion of water vapor from the interior of the tile to its surface.

The larger capillaries and pores dry out first.

The third drying phase is a period when additional physical sorption forces have to be overcome in order to produce further evaporation of the residual water inherent in a material. Consequently the specific heat consumption is increased.

1.3 Over view of roof tile drying and warping

1.



i.

1. Free moisture
2. Bound moisture
3. Molecular moisture

Figure 2 : Moisture in clay

First step is removal of free moisture from the surface of the tile. In our case there is no any moisture over the surface of the tile.

In our drying process the second stage of drying is taking place and shrinkage is significant in this stage. Model is done specially for this stage. When the moisture in second level is uneven, throughout the material warping can take place.

Although shrinkage is significant in 2^{nd} stage drying, initially with high moisture contents the tile is in the plastic range and therefore the warping is not significant. Warping/stress development will be significant in drying (2^{nd} stage) at low moisture contents where tile will be in the elastic range.

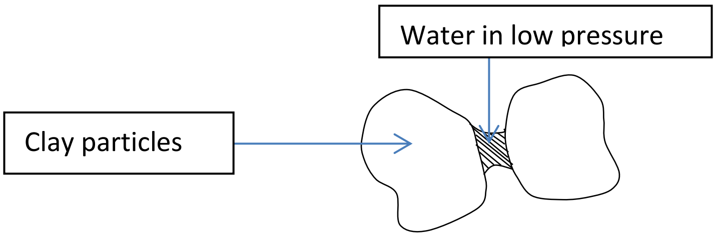


Figure 3 : Illustration of water in clay

Shrinkage is taken place due to capillary action; suction will take place between particles due to attractive forces from water molecules.

1.4 Tile drying

In tile drying the surface moisture (non-chemically bonded) within the tile has to be removed up to 12-14 % other wise cracks warping will form in the firing stage. At the start of drying the tile in the plastic stage and water must be removed from the surface and internal pores gradually in such a way that homogenity related to water in the pore space does not change significantly. Otherwise once the free surface moisture is removed the water in the internal pore spaces will start to decrease and the related moisture content will create a significant gradient and at elastic stage warping and development of strain will form.Vacuum/negative pressure will start to build up within the tile due to hygroscopic action of water. Then after the plastic stage in over this negative pressure will shrink the material while developing warping /cracking in the later stage of drying. Therefore throughout the drying process formation of negative pressure within the tile (this is directly related with shrinkage) has to be uniform as much as possible. To achieve this moisture removal from the surface at different internal moisture contents has to be controlled, by controlling the external humidity and temperature. If the surface moisture removal rate exceeds a certain limit for a particular moisture content homogeneous nature (pore structure) will be distorted increasing the probably of warping cracking.

In this project a model has been developed to understand the moisture removal rate from the surface of the tile with the parameters of moisture content, external temperature and Relative humidity. The effects of these parameters to the drying process are identified by lab tests.

Then from the collected data at Waikkala, moisture removal rates for different moisture contents (without warping and cracking) of the tile at different Temperature and Relative Humidity was considered in the model. Configuration of tile dryer is shown in Figure 4.

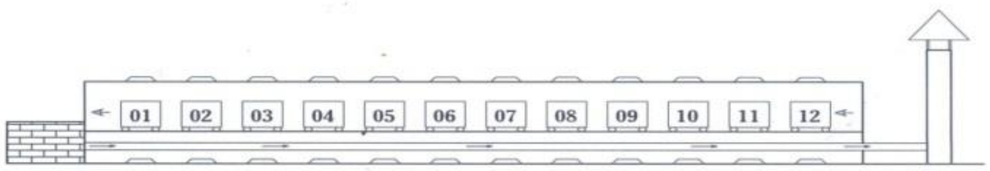


Figure 4 : Schematic view of the tile dryer

2.PROCESS OF ROOFING TILE PRODUCTION

The basic process steps in clay roof tile manufacturing are as follows.

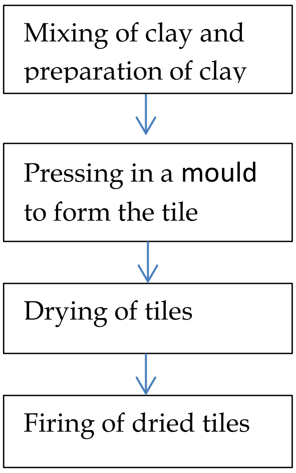


Figure 5 : Basic process steps in clay tile manufacturing

Raw material processing and forming are done in machines and firing is done in a biomass fired kiln. In small scale industries sun drying is done in a shade staked in shelves.

2.1 Drying of roof tiles

The drying of the tile should be in a shade, as otherwise they will warp in the heat of the sun due to effect of the wind. Rapid drying causes tile to be warped or deformed. Therefore, usually it takes a week to get dry during dry season and even two weeks are not enough in a rainy climate. In the Indian subcontinent, and as especially witnessed in Sri Lanka, the formed raw tile is quite wet and an extensive drying process and practice is desired. “It is not possible for the tiles to undergo rapid drying. It would cause the surface hardening and the moisture inside would be trapped, which is undesirable. If the drying rate is too slow, the dryer output would be reduced which affect the production capacity and productivity. Till the moisture diffusivity reaches the beginning of falling the drying has to be controlled”. It is very important to allow removing water from clay tiles until them stiffen up before entering the dryer.

3. MATERIAL AND METHODS

3.1 Tunnel type roof tile dryer

The tunnel type clay roof tile dryer tested under this study, had been designed to process 1080 numbers of tiles at a time. The dryer was fabricated and installed at the Pathiraja Tile Factory at Waikkala, Sri Lanka (Fig.04). The dryer consists of 12 numbers of movable trolleys with each trolley capable of carrying 90 numbers of tiles. Heat pipes carrying hot flue gasses generated by a fuel wood firing furnace to the chimney are located at the lower compartment, underneath the drying chamber (Figure 6).Ambient air enters in to the dryer through adjustable air ports located at both sides of the lower compartment of the dryer, get heated by heat carrying pipes. Humid air exits the drying chamber through vanes located at the top. The dryer could be operated in continuous mode by loading trolleys with tiles at predetermined time intervals at the cold end of the dryer so that tile gets dried while they move on towards hot end of the dryer.

Figure 6 : Roof tile dryer

The tile laden trolleys are moved mechanically by pulling them. This dryer could also be operated in batch mode by loading all the trolleys laden with raw tiles and keeping without being moved until drying is completed.

The forced draft type fuel wood burning furnace provides necessary heat for the dryer. Flue gasses generated from the furnace are directed through a set of pipes located in the lower compartment of the dryer and exit to the atmosphere through a chimney. These heat carrying pipes exchanges the heat with in coming air through natural draft in to the dryer. Trolley is so designed that the tiles are placed at an angle to the incoming air flow for even distribution of air in both sides of a tile.

Figure 7 : Trolley and heat pipe arrangement in the dryer

3.2 Conducting Preliminary drying tests

Trial A was conducted by operating the dryer in continuous mode. In this test run, all the trolleys were loaded to the dryer but only every other trolley was loaded with tiles. Therefore, in Trial A, 540 tiles loaded in to six trolleys. Roof tile dryer trolleys with ninety tiles per trolley, were dried. After operating the furnace, trolleys with tiles were loaded to the dryer from the cold end and moves forward in a predetermined time period.

Trial B was conducted by operating the dryer in batch mode. In Trial B, 1080 tiles were dried using twelve trolleys with ninety tiles loaded to each trolley. Completion of drying was decided by manual scratching method by an expert in the field, which is the traditional practice. In conducting test operations, the furnace was fed with fuel wood manually by monitoring the temperature of the drying compartment at the hot end of the dryer. Temperature and humidity data loggers were fixed to every other trolley, starting from the hot end. The ambient temperature and humidity were also recorded. In both tests before feeding to the dryer tiles were kept outside for some time period ranging from 20 to 24 hours for the purpose of avoiding formation of a high moisture gradient within a tile at the beginning of the drying, which may cause to warping or cracking of tiles.

4. RESULTS AND DISCUSSION

4.1 Results from field test

Test A

Test A was conducted by operating the dryer on continuous mode and 540 numbers of tiles were dried. Retention time in the dryer varied from 54.5 – 61 hrs (Table 01). Tiles were kept outside for 20 -24 h time period before entering to the dryer, total drying time was approximately from 78.5 h (3.3 days) – 85 h (3.5 days). In this drying test operation no warped or deformed tile was observed.

Table 1. Summary of performance Test A of roof tile dryer

Trolley No	Ave. Temp. (C)	Ave. RH (%)	Retention time (h)
1	31.2	70.18	54.5
3	32.1	68.8	63.5
5	32.4	68.7	61.5
7	32.5	69	65
9	32.1	70.8	63
11	32.6	69.7	61

In operating the dryer in Test A, the average ambient temperature and humidity were 29.2 C^0 and 76.8% respectively. Rate of fuel wood consumption was 4 – 5 kg/h

Test B

Test B drying operation was conducted on batch mode. Twelve numbers of trolleys with altogether 1080 numbers of tiles were loaded to the dryer. Trolleys were kept stationary until time of completion of the drying. Retention times in the dryer of tiles were 24 to 36 h. With considering the time period outside the dryer, taken as 24 hrs, total drying time were 48 h (2 days) – 60 hrs (2.5 days). Tiles in 1st trolley which is located at the hottest end of the drier were deformed. Approximately 5% of tiles in 2nd and 3rd trays were deformed. No warping of tiles in rest of the trays.

Table 2 Summary of performance test B of roof tile dryer

Trolley No	Ave. Temp. (C)	Ave. RH (%)	Retention time (h)
1	38.8	53.8	24
3	36.8	59.7	24.5
5	35	64.81	30
7	33.5	71.5	32
9	33.3	73.4	33.5
11	33.5	71.5	36

In operating the dryer in Test B, the average ambient temperature and humidity were 27.4 C^0 and 83.1% respectively. Rate of fuel wood consumption was average 10 kg/h.

In the Test B, the temperature of trolley No.3 (Figure 3 Appendix A) has gone up above the 33^0C level 7 hours after entering to the dryer. But none of the tiles in both of these trollies had been warped. Although the average temperature of trolley No. 3 is 36.8^0C, the average temperature in the first 7 hours was 32^0C. That is before exposing to a temperature in excess of 32^0C, tiles had been dried 24 hr outside the dryer at ambient conditions and 7 hr in the dryer. It gives indication on the critical time period of drying of a tile.

4.2 Discussion

Eventhough two type of test were carried out to see the impact of drying in batch mode and continuous mode but it could not observed.

With the results from the test B it can be conclude that average temperature could be maintaine around 36.8 ^{o}C (From table 2 trolley number 3) and average RH 59.7 for without warping and cracking. These temperature and RH results could be use when to find the maximum possible drying rate for a particular moisture content for without warping and cracking.

4.3 Results from laboratory test

Table 3 Summary of test results from laboratory test.

A drying test was carried out in the laboratory to infer the unknown parameters of the model developed for drying rate. In this test tiles were dried at an environment with known R.H & Temperature; then the weight loss and time was recorded and plotted. The model was not matching with the initial part of drying (Part A of the Figure -8) and this was due to the removal of surface free moisture. The model was developed for drying after the removal of surface –free moisture. (Part B of the Figure -8)

Day	Tem	RH	Sample 01	Sample 02	Sample 03
1	28.6	82.3	4313	4295	4335
2	28.7	82.5	4278	4270	4285
3	27.1	90.3	4228	4231	4185
4	28.3	85.7	4178	4203	4135
5	28.3	83.5	4153	3950	4110
9	28.3	83.4	3892	3875	4077
10	28.5	83.7	3886	3868	4037
11	28.3	83.5	3855	3857	3933
15	28.7	83.1	3815	3625	3902
17	28.5	81.7	3799	3824	3893
18	28.3	83.5	3794	3821	3883
22	28.5	81.9	3784	3819	3871
23	28.3	81.7	3775	3815	3864
24	28.3	81.5	3752	3810	3863

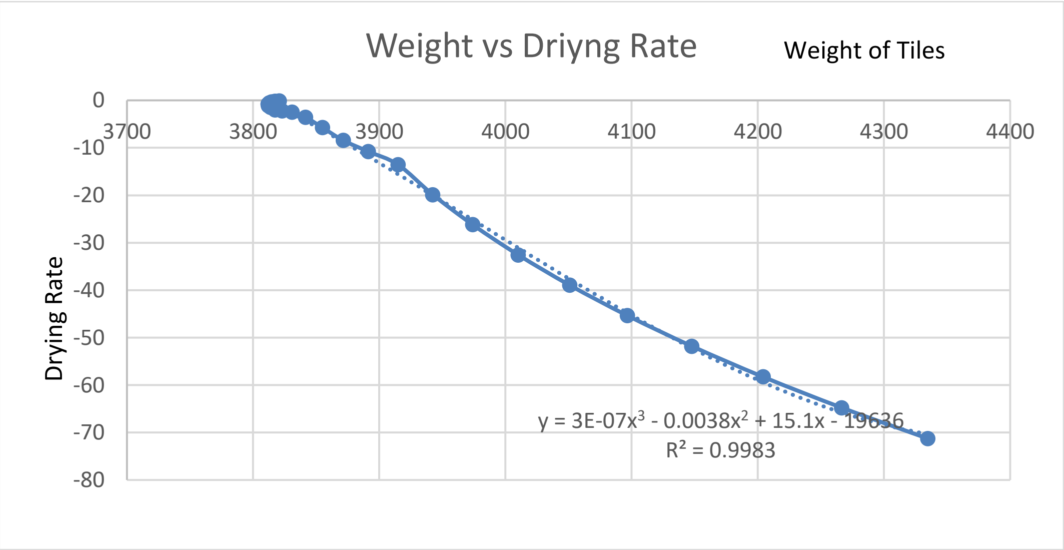


Figure 8 : Weight vs drying rate

This test was done in normal room condition to dry the tile up to the required level. This is same as the tile drying in traditional tile drying. Model was developed based on the results of lab test. This model could be able to validate for the test results obtained from the actual tile drying in tunnel dryer at Vaikkal factory. But this model is not satisfactory for the first drying phase which is the removal of free moisture from the surface. In actual practice of tile drying tiles are fed to the drier after the removal of free moisture. Removal bound moisture will take place in the drier and the model is satisfactory for that stage only.

5. DEVELOPMENT OF THE MODEL FOR TILE DRYING

According to direct observations from the tile drying tests carried out in the tile drier and observations of the tile drying process in the open racks, a simple model of the following type could be assumed.

$\dot{M} = - K_0 (K_1 M^a - Vp)$

Where $\dot{M} = rate\ of\ drying$

Vp = Vapor pressure at relevant temperature and Relative humidity.

M = Weight of the tile

RH = Relative humidity in the relevant environment

K_0 , K_1, a = Constants

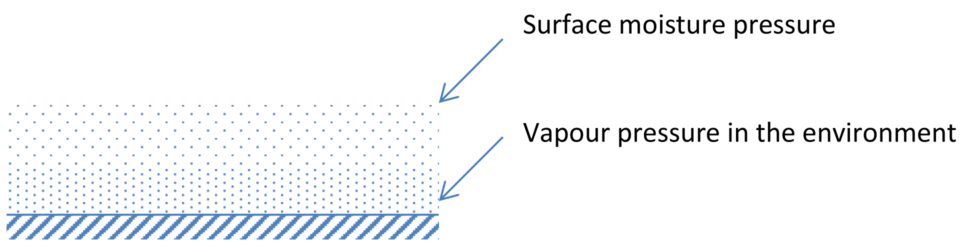


Figure 9 : Removal of moisture from a surface

Surface moisture removal rate is α V_{sp}-V_p and V_{sp} α M^a

M = Moisture content at surface

$dM/dt = -K_o(K_1M^a - V_p)$

Validation of the model as well as inferring the parameters (K_o,K_1,a) of the model was done by the results of the drying test. Because the tile is very thin and the model was developed only for slow drying rates where Warping/Cracking does not take place the gradient of moisture content was considered to be small and therefore the overall moisture content of tile was taken as equal to the surface moisture content.

5.1 Solutions for the mathematical model

$$\dot{M} = -Ko(\dot{K}1M^a - Vp)$$

fit1 **1-10 days**

General model for free moisture stage

f(x) = a*exp(b*x) + c*exp(d*x)

Coefficients (with 95% confidence bounds):

a = -1.622 (-2.404, -0.8402)
b = 0.0008902 (0.0007833, 0.0009971)
c = 2.892e+09 (-2.074e+09, 7.859e+09)
d = -0.004629 (-0.005088, -0.00417)

Goodness of fit:
SSE: 0.01657
R-square: 1
Adjusted R-square: 1
RMSE: 0.05757

fit2 **11-17 days**

Fit computation did not converge:
Fitting stopped because the number of iterations or function evaluations exceeded the specified maximum.

Fit found when optimization terminated:

General model for bound moisture stage

f(x) = a*(b*x^c-4) (This is similar as $\dot{M} = -K_0(K_1M^a - Vp)$)

Coefficients (with 95% confidence bounds):

a = Ko = 0.04953 (-1.095e+04, 1.095e+04)
b = K1 = 6.451 (-1.426e+06, 1.426e+06)
c = a = 1.138 (-11.73, 14.01)

Goodness of fit:
SSE: 161
R-square: 0.9808
Adjusted R-square: 0.9731

RMSE: 5.675

Plot the graph using MATH LAB for the first test result which was carried out in NERDC laboratory. After curve fitting it could able to found out the Ko, K1, and a. In this trial it was observed that drying pattern is not same all over the drying. In free moisture drying is describe by the first drying model and bound moisture drying is describe by the second drying model. First model was solved after curve fitting and found the values for Ko,K1, a and d. Second model also solved and found the values for Ko,K1 and a.(Table-4) It was assume that vapor pressure is same over the total testing period.

Table 4 Solutions for the model

Constants	Model 02
Ko	0.04953
K1	6.451
a	1.138

Table 5: Tabulated results of the field tests verified with the model

Identification	Ave. Temperature	Average RH	Retention time	Final moisture content
Test A trolley 03	32.1	68.8	65.5	9
Test A trolley 11	32.6	69.7	61.0	8
Test B trolley 03	36.6	59.7	24.5	15
Test B trolley 11	33.5	71.5	36.0	12

6. CONCLUTIONS

In this project a simple mathematical model has been developed for drying rate; for the period after the removal of surface moisture and the related parameters were determined by few lab tests. Then by using the drying data collected at tile dryer – Waikkala the model was verified from this drying space drying rates which has taken place without warping at various moisture contents could be inferred. But wether there drying rates are the maximum values for a given moisture content is not known. Therefore further drying tests has to be carried out to determine the maximum possible drying rate for a known moisture content. Then from the model the relevant RH and temperature to chieve that drying rate could be inferred.

Therefore further experimental studies has to be carried out to infer the maximum possible drying rates that could be maintained without warping for various moisture contents of the tile. Also further studies could be carried out to find out the effect of shape of tile on warping as well.
It was assumed that initial weight and moisture content of tiles were constant and similar at the end of drying. Then a model was developed for drying.

$$\dot{M} = -Ko(\dot{K}1M^{a} - Vp)$$

Then K1,K2 and “a” values were found by tests carried out in the NERDC laboratory.

Then results from model and actual results from drying was compared at Vaikkala without warping and cracking.
It was found that final weight of the tile from the model was almost closer to the actual final weight of the tile in tunnel drying.(Tabl 05)

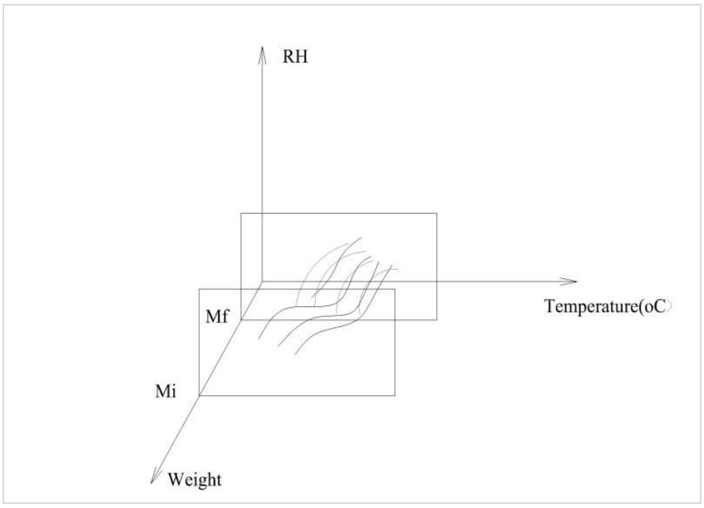


Figure 9: Drying path illustration

Mi = Initial moisture content
Mf = Final moisture content

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Appendix A

Results

1. Moisture Content of the tile calculated from the mathematical model

Table 01, Temperature, RH and calculated vapour pressure and weight of tile in test A trolley No 03.

Time	Temperature in the dryer (° C)	RH in the dryer (%)	Vapour Pressure	Bound Moisture content (M) Vp varying	Bound Moisture content (M) Vp constant
2018-04-03 04:30:00	26.77	66.2	2.75	24	24
4:45	26.74	66.2	2.70	24	24
5:00	26.70	66.3	2.72	24	24
5:15	26.64	66.3	2.76	24	24
5:30	27.74	73.2	3.30	24	24
5:45	27.06	75.9	3.26	23	23
6:00	26.86	77.1	3.40	23	23
6:15	27.07	77.8	3.45	23	23
6:30	27.26	77.4	3.55	23	23
6:45	27.68	77.3	3.65	23	23
7:00	28.16	75.4	3.50	23	23
7:15	29.01	75.2	3.75	23	23
7:30	29.70	72.5	3.60	23	23
7:45	30.31	69.9	3.74	22	22
8:00	31.08	72.0	4.00	22	22
8:15	31.71	68.6	3.88	22	22
8:30	32.09	69.9	4.00	22	22
8:45	32.45	69.0	4.05	22	22
9:00	32.63	66.7	3.95	22	22
9:15	32.52	68.2	4.06	22	22
9:30	32.17	69.0	4.07	22	22
9:45	31.75	70.8	4.02	22	22
10:00	31.63	70.6	4.06	21	21
10:15	31.90	70.7	4.05	21	21
10:30	32.13	70.2	4.10	21	21
10:45	32.22	69.7	4.06	21	21
11:00	32.27	69.4	4.04	21	21
11:15	32.34	68.3	4.07	21	21
11:30	32.52	68.8	4.05	21	21
11:45	32.59	68.6	4.09	21	21
12:00	32.65	68.8	4.05	21	21
12:15	32.72	68.0	4.01	21	21
12:30	32.76	69.2	4.15	20	20
12:45	32.84	69.6	4.17	20	20
13:00	32.72	69.5	4.25	20	20
13:15	32.26	71.1	4.55	20	20
13:30	32.11	70.6	4.25	20	20
13:45	32.09	70.9	4.15	20	20
14:00	32.06	71.2	4.10	20	20

14:15	31.98	70.8	4.11	20	20
14:30	32.01	70.6	4.09	20	20
14:45	32.23	71.1	4.23	20	20
15:00	32.30	70.9	4.25	19	19
15:15	32.43	70.4	4.22	19	19
15:30	32.51	70.3	4.35	19	19
15:45	32.48	70.4	4.05	19	19
16:00	32.42	70.6	4.35	19	19
16:15	32.40	71.0	4.40	19	19
16:30	32.37	71.2	4.41	19	19
16:45	32.27	71.4	4.35	19	19
17:00	31.92	71.6	4.30	19	19
17:15	31.66	74.0	4.32	19	19
17:30	31.53	73.8	4.25	19	19
17:45	31.60	73.9	4.23	18	18
18:00	31.75	73.1	4.26	18	18
18:15	31.87	73.1	4.10	18	18
18:30	31.84	73.0	4.11	18	18
18:45	31.79	73.7	4.28	18	18
19:00	31.70	74.0	4.26	18	18
19:15	31.59	73.9	4.29	18	18
19:30	31.53	74.5	4.24	18	18
19:45	31.45	74.6	4.26	18	18
20:00	31.42	74.7	4.02	18	18
20:15	31.26	73.7	4.04	18	18
20:30	31.11	73.3	4.27	17	17
20:45	31.05	73.9	4.19	17	17
21:00	31.03	75.1	3.96	17	17
21:15	31.12	74.0	4.00	17	17
21:30	31.09	73.1	3.75	17	17
21:45	30.93	72.6	3.98	17	17
22:00	30.76	72.4	4.00	17	17
22:15	30.61	72.8	3.83	17	17
22:30	30.52	71.5	3.96	17	17
22:45	30.44	71.7	3.99	17	17
23:00	30.45	71.1	3.97	17	17
23:15	30.49	71.8	4.00	17	17
23:30	30.52	72.1	3.75	16	16
23:45	30.51	72.1	3.70	16	16
2018-04-04 00:00:00	30.41	72.1	3.98	16	16
0:15	30.28	72.7	3.75	16	16
0:30	30.11	73.1	3.80	16	16
0:45	29.92	73.7	3.85	16	16
1:00	29.74	74.4	3.65	16	16
1:15	29.57	74.9	3.75	16	16

1:30	29.11	72.9	3.80	16	16
1:45	28.93	75.4	3.78	16	16
2:00	28.91	76.0	3.81	16	16
2:15	28.78	77.1	3.74	16	16
2:30	28.81	76.8	3.76	16	16
2:45	28.84	77.6	3.65	15	16
3:00	28.86	77.0	3.77	15	15
3:15	28.93	76.8	3.75	15	15
3:30	28.97	77.1	3.75	15	15
3:45	29.11	76.9	3.76	15	15
4:00	29.31	76.1	3.80	15	15
4:15	29.43	75.8	3.63	15	15
4:30	29.56	75.0	3.60	15	15
4:45	29.41	72.1	3.55	15	15
5:00	29.02	72.4	3.45	15	15
5:15	28.73	73.9	3.55	15	15
5:30	28.42	73.9	3.30	15	15
5:45	28.10	75.2	3.66	15	15
6:00	27.90	75.9	3.65	15	15
6:15	27.89	78.4	3.75	15	15
6:30	27.89	79.5	3.55	14	14
6:45	27.85	79.2	3.65	14	14
7:00	27.85	79.3	3.75	14	14
7:15	27.93	78.9	3.74	14	14
7:30	28.02	79.6	3.80	14	14
7:45	28.15	79.8	3.78	14	14
8:00	28.42	79.3	3.76	14	14
8:15	28.76	79.2	3.80	14	14
8:30	29.08	78.3	3.85	14	14
8:45	29.39	77.9	3.95	14	14
9:00	29.68	76.8	4.00	14	14
9:15	29.89	77.1	3.98	14	14
9:30	30.27	76.1	4.04	14	14
9:45	30.71	75.1	4.10	14	14
10:00	31.18	72.5	4.03	14	14
10:15	31.52	72.3	3.98	13	13
10:30	31.75	71.0	3.79	13	13
10:45	32.96	66.2	4.10	13	13
11:00	33.08	62.4	4.05	13	13
11:41	33.81	64.2	4.11	13	13
11:56	34.42	61.6	3.94	13	13
12:11	34.80	62.5	3.98	13	13
12:26	34.86	59.0	4.04	13	13
12:41	34.66	60.9	4.18	13	13
12:56	34.52	62.8	3.85	13	13

13:11	34.28	62.8	3.89	13	13
13:26	33.89	62.8	4.09	13	13
13:41	33.63	63.5	4.00	13	13
13:56	33.49	66.0	4.01	13	13
14:11	33.29	64.4	4.20	13	13
14:26	33.07	67.1	4.25	13	13
14:41	33.01	67.6	4.03	13	13
14:56	32.90	68.3	4.02	12	12
15:11	32.83	69.1	4.03	12	12
15:26	32.71	69.6	4.10	12	12
15:41	32.60	69.2	4.09	12	12
15:56	32.53	69.2	4.20	12	12
16:11	32.43	68.3	4.06	12	12
16:26	32.33	70.4	3.97	12	12
16:41	32.25	69.0	4.10	12	12
16:56	32.13	68.9	4.25	12	12
17:11	31.95	71.4	4.11	12	12
17:26	31.87	73.1	3.95	12	12
17:41	31.73	72.7	4.04	12	12
17:56	31.55	71.7	4.03	12	12
18:11	31.43	72.3	4.05	12	12
18:26	31.22	72.3	4.06	12	12
18:41	31.17	74.3	4.00	12	12
18:56	31.07	75.4	4.08	12	12
19:11	30.99	75.1	4.14	12	12
19:26	30.88	76.1	4.02	11	11
19:41	30.80	76.9	4.10	11	11
19:56	30.71	76.1	4.02	11	11
20:11	30.62	77.0	4.06	11	11
20:26	30.53	77.4	4.08	11	11
20:41	30.43	78.1	4.09	11	11
20:56	30.43	77.8	4.00	11	11
21:11	30.51	77.1	4.04	11	11
21:26	30.58	75.8	3.90	11	11
21:41	30.58	76.4	4.23	11	11
21:56	30.84	75.9	4.05	11	11
22:11	31.31	74.5	4.04	11	11
22:26	31.55	73.9	4.03	11	11
22:41	31.64	73.1	4.10	11	11
22:56	31.53	72.6	4.09	11	11
23:11	31.93	73.6	4.04	11	11
23:26	32.06	72.7	4.05	11	11
23:41	32.18	70.6	4.30	11	11
23:56	31.79	72.9	4.06	11	11
2018-04-05 00:11:00	31.22	75.0	4.24	11	11

0:26	30.65	78.2	4.04	11	11
0:41	30.07	79.0	4.18	10	10
0:56	29.56	81.7	4.10	10	10
1:11	29.16	83.2	4.25	10	10
1:26	29.16	84.3	4.48	10	10
1:41	32.68	72.6	4.35	10	10
1:56	36.44	60.6	4.20	10	10
2:11	39.32	52.4	4.40	10	10
2:26	40.60	48.5	4.20	10	10
2:41	40.50	49.1	4.22	10	10
2:56	39.28	50.9	4.25	10	10
3:11	38.31	52.7	4.26	10	10
3:26	37.49	55.9	4.30	10	10
3:41	36.98	57.3	4.25	10	10
3:56	36.23	58.3	4.10	10	10
4:11	35.50	60.4	4.25	10	10
4:26	34.82	62.9	4.27	10	10
4:41	34.12	65.7	3.96	10	10
4:56	33.57	67.0	4.01	10	10
5:11	32.93	69.0	4.00	10	10
5:26	32.68	68.3	3.98	10	10
5:41	32.46	69.5	4.10	10	10
5:56	32.15	68.9	4.11	10	10
6:11	32.22	70.4	4.10	9	9
6:26	32.18	71.1	4.11	9	9
6:41	32.10	71.3	4.06	9	9
6:56	32.08	72.1	4.23	9	9
7:11	32.03	71.5	4.10	9	9
7:26	32.09	71.2	4.25	9	9
7:41	33.29	68.6	4.19	9	9
7:56	35.41	61.9	4.12	9	9
8:11	36.09	59.9	4.25	9	9
8:26	36.54	58.6	4.25	9	9
8:41	36.74	57.9	4.12	9	9
8:56	36.57	56.5	3.98	9	9
9:11	36.39	59.3	4.21	9	9
9:26	36.12	59.2	4.20	9	9
9:41	35.91	56.6	3.10	9	9
9:56	35.36	60.5	4.12	9	9
10:11	35.15	59.4	4.00	9	9
10:26	34.81	60.2	4.01	9	9
10:41	34.95	62.3	4.10	9	9
10:56	34.91	62.4	4.09	9	9
11:11	35.57	60.7	4.25	9	9
11:26	38.19	52.0	4.21	9	9

11:41	38.98	48.2	3.95	9	9
11:56	38.54	50.6	54.00	9	9
12:11	37.37	54.2	4.04	9	9
12:26	37.11	53.5	4.00	9	9
12:41	37.16	53.6	4.01	9	8
12:56	38.20	52.9	4.10	8	8
13:11	38.78	52.0	4.11	8	8
13:26	39.00	52.5	4.25	8	8
13:41	39.13	51.6	4.05	8	8
13:56	39.20	49.8	4.21	8	8
14:11	39.01	51.5	4.23	8	8
14:26	38.65	52.2	4.10	8	8
14:41	38.22	52.5	4.02	8	8
14:56	37.67	54.3	4.21	8	8
15:11	37.56	54.2	4.25	8	8
15:26	37.51	55.2	4.21	8	8
15:41	37.46	54.8	4.25	8	8
15:56	36.72	54.5	4.07	8	8
16:11	37.28	54.3	4.04	8	8
16:26	37.53	53.9	4.12	8	8
16:41	37.47	54.4	4.24	8	8
16:56	37.47	54.7	4.26	8	8
17:11	37.74	53.8	4.35	8	8
17:26	38.40	51.4	4.04	8	8
17:41	38.28	51.1	4.12	8	8
2018-04-05 17:56:00	38.34	51.5	4.09	8	8

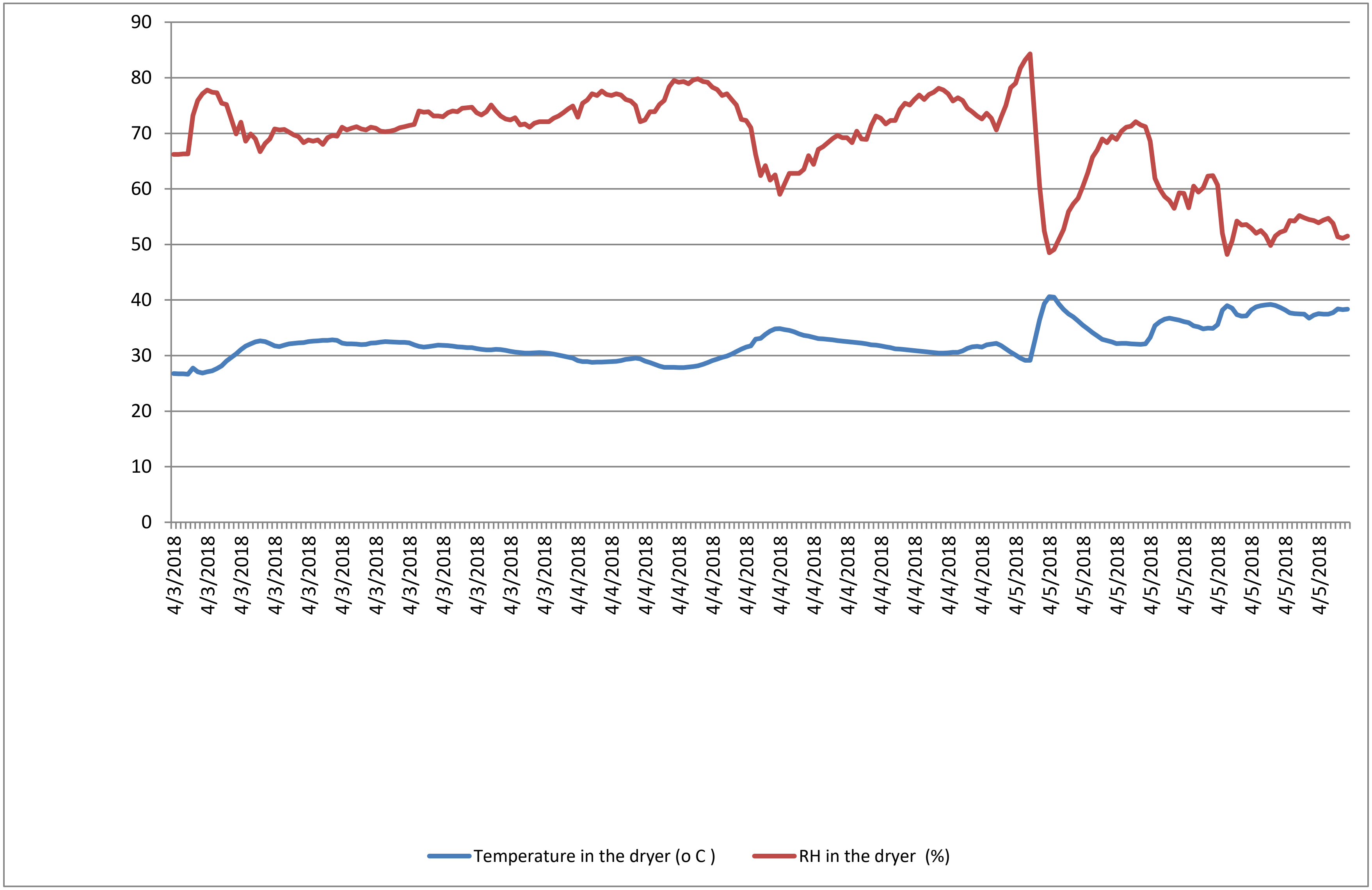

Fig.01- Test A; Trolley No 3; Variation of temperature and humidity in the dryer when the dryer operate on Continuous mode.

Table-02 Temperature, RH and calculated vapour pressure and weight of tile in test A trolley No 11.

Date & Time	Temperature inside the dryer (C)	RH In the dryer (%)	Vapour pressure	Bound Moisture content (M) Vp varying	Bound Moisture content (M) Vp constant
2018-04-04; 6.52	26.94	82.5	3.51	24	24
7.07	27.05	82.1	3.55	24	24
7.22	27.26	80.2	3.55	24	24
7.37	27.52	79.5	3.50	24	24
7.52	27.77	79.6	3.55	24	24
8.07	28.21	78.8	3.75	23	23
8.22	28.59	78.0	3.75	23	23
8.37	29.02	77.6	3.78	23	23
8.52	29.39	75.7	3.77	23	23
9.07	29.67	74.5	3.78	23	23
9.22	29.93	76.3	3.80	23	23
9.37	30.26	72.8	3.75	23	23
9.52	30.60	72.7	3.81	23	23
10.70	30.93	73.0	3.79	22	22
10.22	31.23	72.3	3.94	22	22
10.37	31.42	70.9	4.00	22	22
10.52	32.11	68.4	3.80	22	22
11.07	32.15	68.0	3.85	22	22
11.22	32.50	67.5	3.98	22	22
11.37	33.36	65.5	4.01	22	22
11.52	33.83	64.3	4.01	22	22
12.07	34.19	63.6	4.05	22	22
12.22	34.34	63.4	4.00	21	21
12.37	34.30	62.4	4.04	21	21
12.52	34.13	63.4	4.06	21	21
13.07	34.00	64.5	4.07	21	21
13.22	33.63	65.4	4.05	21	21
13.37	33.44	65.2	4.10	21	21
13.52	33.34	66.9	4.06	21	21
14.07	33.20	67.8	4.10	21	21
14.22	33.01	68.3	4.00	21	21
14.37	32.89	69.0	4.03	21	21
14.37	32.80	69.3	4.05	20	20

15.07	32.73	70.2	4.10	20	20
15.22	32.63	70.2	4.09	20	20
15.37	32.51	70.5	4.23	20	20
15.52	32.47	70.7	4.00	20	20
16.07	32.37	70.4	4.20	20	20
16.22	32.27	70.8	4.06	20	20
16.37	32.16	72.1	4.30	20	20
16.52	31.96	71.7	4.05	20	20
17.07	31.75	72.1	4.11	20	20
17.22	31.68	72.8	4.03	19	19
17.37	31.58	73.2	4.04	19	19
17.52	31.43	73.8	4.04	19	19
18.07	31.26	74.8	4.02	19	19
18.22	31.13	74.6	3.55	19	19
18.37	31.00	75.4	4.00	19	19
18.52	30.89	76.1	4.02	19	19
19.07	30.77	76.4	4.03	19	19
19.22	30.68	76.5	3.95	19	19
19.37	30.60	76.5	4.01	19	19
19.52	30.53	76.6	3.95	19	19
20.07	30.45	76.6	3.90	18	18
20.22	30.36	76.7	3.99	18	18
20.37	30.26	77.0	4.21	18	18
20.52	30.16	77.8	4.05	18	18
21.07	30.19	77.0	3.99	18	18
21.22	30.17	77.4	3.93	18	18
21.37	30.07	78.0	3.88	18	18
21.52	30.13	78.8	4.02	18	18
22.07	30.33	78.2	4.06	18	18
22.22	30.49	77.8	4.04	18	18
22.37	30.59	77.3	4.05	18	18
22.52	30.60	76.8	4.00	17	17
23.07	30.77	78.1	4.08	17	17
23.22	31.09	76.4	4.25	17	17
23.37	31.34	75.7	4.05	17	17
23.52	31.30	74.6	4.01	17	17
2018-04-4-05 ;0.07	30.87	76.3	4.02	17	17
0.22	30.31	78.9	4.01	17	17
0.37	29.71	78.8	3.98	17	17
0.52	29.23	80.8	3.99	17	17
1.07	28.82	81.7	3.75	17	17

1.22	28.49	83.6	3.81	17	17
1.37	29.85	83.0	4.10	17	17
1.52	31.90	76.7	4.09	16	16
2.07	33.68	71.1	4.43	16	16
2.22	35.73	65.0	4.51	16	16
2.37	37.11	61.4	4.55	16	16
2.52	37.62	59.1	4.51	16	16
3.07	37.47	58.9	4.40	16	16
3.22	37.02	60.0	4.50	16	16
3.37	36.33	62.6	4.48	16	16
3.52	35.53	64.0	4.60	16	16
4.07	34.80	66.6	4.45	16	16
4.22	34.10	68.0	4.40	16	16
4.37	33.46	69.8	4.05	16	16
4.52	32.81	71.1	4.05	16	16
5.07	32.25	72.7	4.19	16	16
5.22	31.83	75.1	4.25	15	15
5.37	31.57	74.4	4.10	15	15
5.52	31.29	75.8	4.06	15	15
6.07	31.26	76.1	4.11	15	15
6.22	31.27	75.8	4.25	15	15
6.37	31.21	76.2	4.24	15	15
6.52	31.19	76.3	4.11	15	15
7.07	31.19	76.3	4.23	15	15
7.22	31.11	76.2	4.09	15	15
7.37	31.19	76.6	4.25	15	15
7.52	32.19	73.9	4.23	15	15
8.07	33.26	71.9	4.48	15	15
8.22	34.10	69.1	4.48	15	15
8.37	34.73	67.0	4.47	15	15
8.52	35.04	65.9	4.50	14	14
9.07	35.17	66.4	4.51	14	14
9.22	35.21	64.2	4.42	14	14
9.37	35.14	63.6	4.40	14	14
9.52	34.90	64.4	4.26	14	14
10.07	34.60	66.0	4.40	14	14
10.22	34.41	67.0	4.25	14	14
10.37	34.36	66.9	4.50	14	14
10.52	34.30	66.9	4.26	14	14
11.07	34.29	67.4	4.46	14	14
11.22	35.21	64.8	4.48	14	14
11.37	37.04	59.9	4.20	14	14

11.52	38.34	53.4	4.21	14	14
12.07	38.51	53.7	4.25	14	14
12.22	38.14	54.7	4.25	14	14
12.37	37.93	57.6	4.50	13	13
12.52	38.10	56.9	4.50	13	13
13.07	38.24	57.3	4.54	13	13
13.22	38.16	57.8	4.40	13	13
13.37	38.15	57.4	4.50	13	13
13.52	38.11	56.4	4.48	13	13
14.07	37.99	57.4	4.47	13	13
14.22	37.73	57.5	4.30	13	13
14.37	37.40	57.3	4.21	13	13
14.52	36.83	58.0	4.10	13	13
15.07	36.62	58.8	4.30	13	13
15.22	36.44	60.7	4.48	13	13
15.37	36.43	60.7	4.30	13	13
15.52	36.23	60.7	4.41	13	13
16.07	35.80	62.1	4.25	13	13
16.22	35.80	62.0	4.30	13	13
16.37	35.74	61.9	4.10	13	13
16.52	35.60	61.7	4.21	12	12
17.07	35.43	63.0	4.35	12	12
17.22	35.42	63.3	4.19	12	12
17.37	35.55	62.2	4.21	12	12
17.52	35.64	63.2	4.25	12	12
18.07	35.56	61.7	4.10	12	12
18.22	35.36	59.9	4.01	12	12
18.37	35.22	63.2	4.24	12	12
18.52	35.31	62.8	4.04	12	12
19.07	35.13	63.3	4.05	12	12
19.22	34.96	63.4	4.07	12	12
19.37	34.66	64.8	4.30	12	12
19.52	34.40	65.3	4.24	12	12
20.07	34.07	66.0	4.01	12	12
20.22	33.82	66.8	4.07	12	12
20.37	33.34	66.7	4.10	12	12
20.52	32.76	67.2	4.01	12	12
21.07	32.30	69.0	3.75	12	12
21.22	31.94	69.6	3.80	11	11
21.37	31.79	70.3	3.98	11	11
21.52	31.70	70.3	4.06	11	11
22.07	31.58	70.8	4.00	11	11

22.22	31.45	71.2	4.03	11	11
22.37	31.32	71.8	4.02	11	11
22.52	31.19	72.3	4.01	11	11
23.07	31.06	72.8	3.96	11	11
23.22	30.93	73.3	3.88	11	11
23.37	30.77	73.9	3.89	11	11
23.52	30.61	74.6	3.96	11	11
2018-04-06; 0.07	30.45	74.8	3.98	11	11
0.22	30.34	75.3	3.81	11	11
0.37	30.24	75.3	3.78	11	11
0.52	30.11	75.5	3.82	11	11
1.07	29.97	75.9	3.85	11	11
1.22	29.82	76.3	3.80	11	11
1.37	29.65	76.4	3.79	11	11
1.52	29.54	76.8	3.73	11	11
2.07	29.41	77.4	3.74	11	11
2.22	29.29	77.8	3.75	11	11
2.37	29.15	77.7	3.70	10	10
2.52	29.03	78.3	3.63	10	10
3.07	28.91	78.5	3.59	10	10
3.22	28.80	78.9	3.60	10	10
3.37	28.68	79.5	3.60	10	10
3.52	28.48	79.4	3.55	10	10
4.07	28.32	80.2	3.78	10	10
4.22	28.48	79.8	3.60	10	10
4.37	28.71	79.1	3.70	10	10
4.52	28.92	78.3	3.76	10	10
5.07	29.01	77.7	3.75	10	10
5.22	29.14	77.3	3.65	10	10
5.37	29.17	76.9	3.75	10	10
5.52	29.10	77.0	3.55	10	10
6.07	29.34	76.2	3.60	10	10
6.22	29.70	75.2	3.75	10	10
6.37	30.28	73.6	3.76	10	10
6.52	30.92	72.1	3.80	10	10
7.07	31.34	70.9	3.79	10	10
7.22	31.77	69.8	3.90	10	10
7.37	32.44	68.1	3.80	10	10
7.52	33.36	66.2	4.00	10	10
8.07	33.88	64.5	4.02	10	9
8.22	34.06	64.0	4.23	9	9
8.37	34.13	64.1	4.22	9	9

8.52	34.11	64.0	3.94	9	9
9.07	34.05	63.8	4.00	9	9
9.22	33.69	63.9	4.01	9	9
9.37	33.80	64.9	4.23	9	9
9.52	33.85	65.2	4.02	9	9
10.07	33.94	64.3	4.06	9	9
10.22	33.89	64.3	4.24	9	9
10.37	33.64	65.0	4.23	9	9
10.52	33.51	66.3	4.11	9	9
11.07	34.54	64.1	4.10	9	9
11.22	35.44	62.8	4.20	9	9
11.37	35.93	60.5	4.04	9	9
11.52	36.09	60.8	3.97	9	9
12.07	36.26	60.1	3.98	9	9
12.22	35.90	59.2	4.02	9	9
12.37	34.76	59.5	4.04	9	9
12.52	33.94	60.1	4.01	9	9
13.07	33.43	64.8	3.98	9	9
13.22	34.57	61.7	4.04	9	9
13.37	35.03	60.1	4.21	9	9
2018-04-06; 13.52	35.16	59.9	3.98	9	9

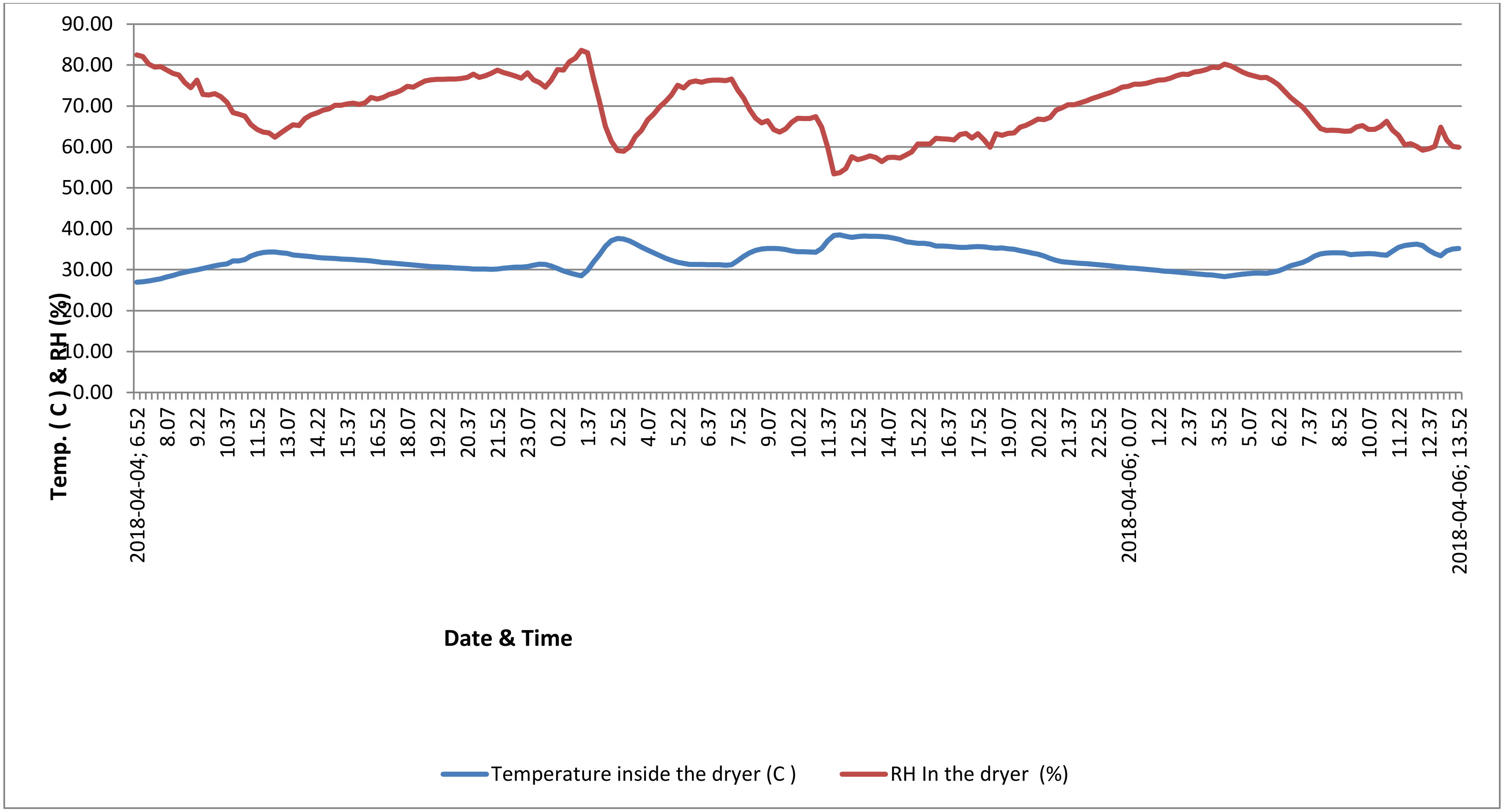

Fig.02- Test A; Trolley No 11; Variation of temperature and humidity in the dryer when the dryer operate on Continuous mode.

Table - 03. Temperature, RH and calculated vapour pressure and weight of tile in test B trolley No 3

Date & Time	Temperatture (o C)	RH (%)	Vapour Pressure	Bound Moisture content (M) Vp varying	Bound Moisture content (M) Vp constant
2018.04.25; 12.00	32.38	65.3	3.76	24	24
12.15	32.05	67.0	3.85	24	24
12.30	32.76	65.5	3.75	24	24
12.45	32.94	67.0	3.91	24	24
13.00	32.80	65.9	4.02	24	24
13.15	32.50	66.3	4.85	23	23
13.20	33.07	67.7	3.97	23	23
13.45	32.36	69.5	3.98	23	23
14.00	31.75	72.9	4.15	23	23
14.15	31.54	73.9	4.17	23	23
14.30	31.28	73.6	4.15	23	23
14.45	31.18	75.3	4.12	23	23
15.00	30.97	76.3	4.00	23	23
15.15	30.90	74.6	3.85	22	22
15.30	30.79	76.4	4.03	22	22
15.45	30.74	78.2	4.04	22	22
16.00	30.64	80.3	4.24	22	22
16.15	30.81	80.8	4.25	22	22
16.30	30.84	79.2	4.23	22	22
16.45	31.29	79.7	4.26	22	22
17.00	31.84	77.1	4.24	22	22
17.15	32.26	76.2	4.48	22	22
17.30	32.24	77.1	4.47	21	21
17.45	32.41	77.8	4.48	21	21
18.00	32.43	78.3	4.51	21	21
18.15	32.54	77.6	4.49	21	21
18.30	32.98	77.5	4.52	21	21
18.45	33.79	74.2	4.51	21	21
19.00	34.30	71.8	4.50	21	21
19.15	36.11	68.1	4.80	21	21
19.30	38.31	61.3	5.00	21	21
19.45	39.53	55.6	4.60	21	21
20.00	40.55	48.3	4.09	20	20
20.15	40.55	50.3	4.25	20	20

20.30	39.76	49.5	4.05	20	20
20.45	38.61	50.0	4.00	20	20
21.00	37.46	54.8	4.01	20	20
21.15	38.67	53.1	4.26	20	20
21.30	39.82	50.9	4.05	20	20
21.45	41.81	47.6	4.48	20	20
22.00	43.16	45.2	4.50	20	20
22.15	43.53	44.3	4.60	20	20
22.30	42.57	46.5	4.50	19	19
22.45	41.25	49.3	4.51	19	19
23.00	39.98	51.7	4.27	19	19
23.15	38.82	54.6	4.24	19	19
23.30	37.77	56.5	4.48	19	19
23.45	36.92	57.8	4.21	19	19
2018.04.26; 00:00	36.11	59.9	4.12	19	19
0.15	35.44	61.4	4.21	19	19
0.30	34.89	61.7	4.04	19	19
0.45	34.58	63.6	4.06	19	19
1.00	35.24	62.0	4.24	19	19
1.15	36.68	59.2	4.12	18	18
1.30	37.87	55.5	4.05	18	18
1.45	38.42	54.7	4.48	18	18
2.00	38.52	54.2	4.48	18	18
2.15	38.28	54.2	4.24	18	18
2.30	37.79	54.8	4.05	18	18
2.45	37.20	55.4	4.04	18	18
3.00	36.62	57.0	4.23	18	18
3.15	35.87	60.0	4.13	18	18
3.30	37.32	57.2	4.15	18	18
3.45	39.57	52.0	4.48	18	18
4.00	41.29	47.7	4.21	17	17
4.15	42.16	46.1	4.12	17	17
4.30	42.39	45.7	4.21	17	17
4.45	42.23	45.6	4.04	17	17
5.00	42.29	46.2	4.06	17	17
5.15	42.14	44.7	4.24	17	17

5.30	41.62	47.6	4.12	17	17
5.45	40.95	48.8	4.05	17	17
6.00	40.28	49.4	4.48	17	17
6.15	39.50	50.8	4.48	17	17
6.30	39.19	52.7	4.24	17	17
6.45	39.70	51.2	4.05	17	17
7.00	40.30	48.8	4.04	16	16
7.15	40.37	47.1	4.23	16	16
7.30	40.15	50.1	4.13	16	16
7.45	40.16	50.5	4.15	16	16
8.00	40.19	51.1	4.21	16	16
8.15	39.99	52.3	4.25	16	16
8.30	39.78	52.5	4.35	16	16
8.45	39.56	51.4	4.30	16	16
9.00	39.24	55.4	4.31	16	16
9.15	39.33	50.6	4.48	16	16
9.30	39.33	53.1	4.48	16	16
9.45	39.15	52.9	4.47	16	16
10.00	38.48	53.0	4.25	16	16
10.15	37.95	54.3	4.09	16	16
10.30	37.13	58.8	4.27	15	15
10.45	36.85	59.1	4.21	15	15
11.00	36.31	59.9	4.23	15	15
11.15	35.74	61.6	4.25	15	15
11.30	35.29	62.4	4.25	15	15
11.45	35.00	62.6	4.47	15	15
12.00	34.80	62.9	4.21	15	15
12.15	34.43	62.3	4.01	15	15
12.30	33.70	67.1	4.24	15	15

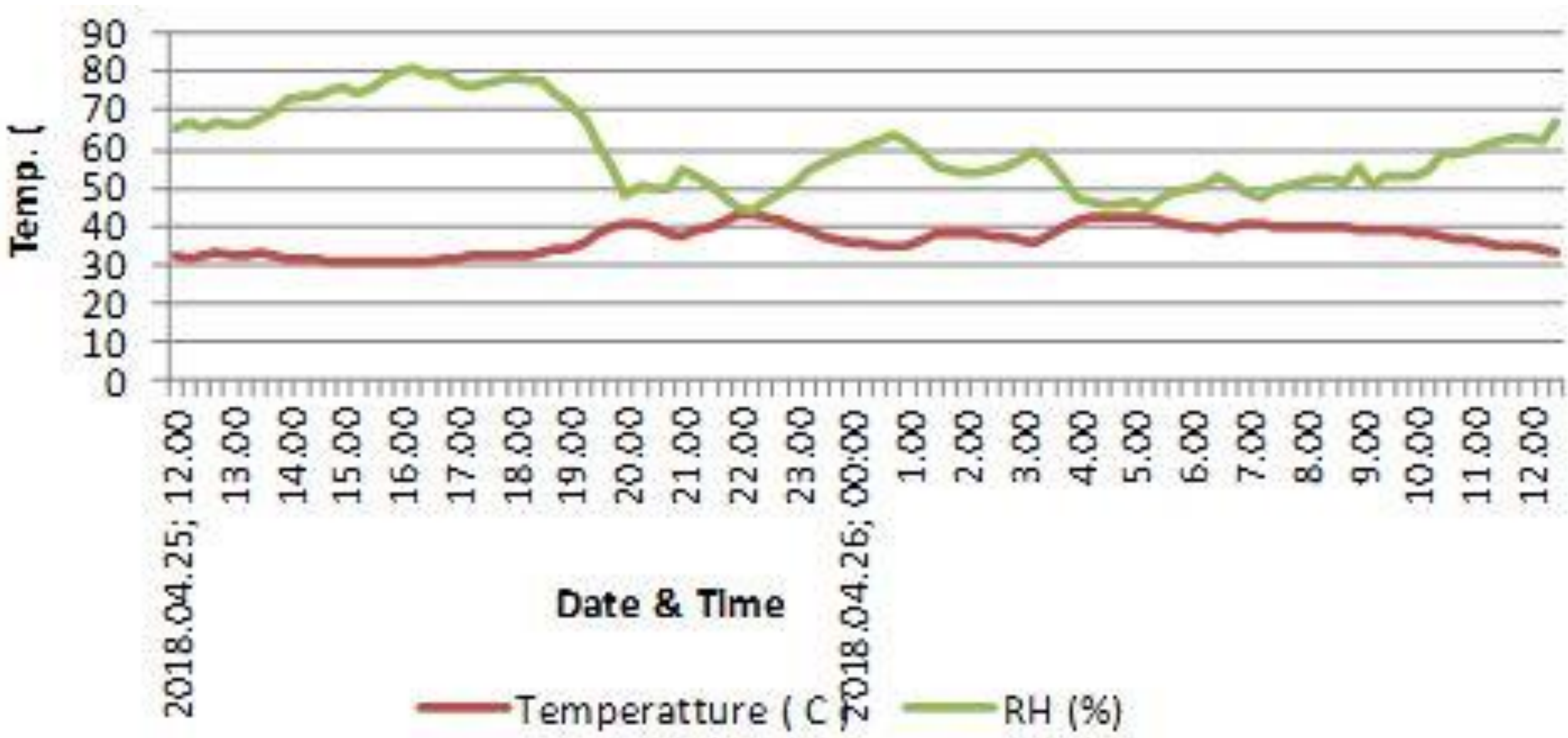

Fig.03- Test B; Trolley No 3; Variation of temperature and humidity in the dryer when the dryer operate on Batch mode.

Table - 04. Temperature, RH and calculated vapour pressure and Calculated weight of tile in test B trolley No 11

Time	Temperature in the dryer (°C)	RH in the dryer (%)	Vapour Pressure	Bound Moisture content (M) Vp varying	Bound Moisture content (M) Vp constant
2018.04.25 ;18.00	30.82	81.9	4.25	24	24
18.15	30.80	82.5	4.47	24	24
18.30	30.93	82.5	4.5	24	24
18.45	31.17	82.3	4.5	24	24
19.00	31.38	81.8	4.58	24	24
19.15	32.04	80.1	4.65	23	23
19.30	32.81	78.5	4.51	23	23
19.45	33.12	74.5	4.5	23	23
20.00	33.38	69.9	4.25	23	23
20.15	33.18	73.2	4.49	23	23
20.30	33.25	73.7	4.49	23	23
20.45	33.08	72.6	4.26	23	23
21.00	32.65	74.0	4.25	23	23
21.15	32.85	73.5	4.25	22	22
21.30	33.18	72.8	4.48	22	22
21.45	33.83	72.5	4.5	22	22
22.00	34.47	71.8	4.57	22	22
22.15	34.94	71.4	4.65	22	22
22.30	34.95	72.0	4.75	22	22
22.45	34.57	72.9	4.65	22	22
23.00	34.11	74.0	4.75	22	22
23.15	33.61	74.6	4.65	22	22
23.30	33.15	75.8	4.57	21	21
23.45	32.69	75.9	4.49	21	21
2018.04.26; 00:00	32.29	77.5	5.05	21	21
0.15	31.90	76.1	4.3	21	21
0.30	31.57	78.1	4.25	21	21
0.45	31.35	79.5	4.26	21	21
2018.04.26;1.00	31.50	78.4	4.25	21	21
1.15	31.76	77.6	4.25	21	21
1.30	31.95	77.8	4.24	21	21
1.45	32.05	76.8	4.25	21	21
2.00	32.11	78.0	4.26	20	20
2.15	32.01	77.5	4.48	20	20
2.30	31.84	76.6	4.23	20	20
2.45	31.64	78.8	4.25	20	20

3.00	31.49	78.2	4.26	20	20
3.15	31.24	79.5	4.41	20	20
3.30	31.74	78.2	4.35	20	20
3.45	32.54	75.2	4.47	20	20
4.00	33.30	74.2	4.51	20	20
4.15	33.79	73.1	4.53	20	20
4.30	34.11	72.8	4.51	19	19
4.45	34.22	73.2	4.52	19	19
5.00	34.34	72.5	4.58	19	19
5.15	34.40	73.1	4.26	19	19
5.30	34.29	72.9	4.58	19	19
5.45	34.12	73.9	4.59	19	19
6.00	33.89	73.8	4.53	19	19
6.15	33.58	74.6	4.51	19	19
6.30	33.38	74.3	4.5	19	19
6.45	33.47	74.1	4.65	19	19
7.00	33.52	75.0	4.75	19	19
7.15	33.55	75.2	4.52	18	18
7.30	33.54	73.9	4.55	18	18
7.45	33.61	73.7	4.65	18	18
8.00	33.78	74.4	4.51	18	18
8.15	33.82	73.6	4.75	18	18
8.30	33.82	74.3	4.52	18	18
8.45	33.89	74.7	4.57	18	18
9.00	33.85	75.0	4.65	18	18
9.15	33.95	75.2	4.55	18	18
9.30	34.05	75.1	4.75	18	18
9.45	34.01	76.3	4.48	18	18
10.00	33.89	74.5	4.55	17	17
10.15	33.73	76.6	4.75	17	17
10.30	33.68	76.0	4.74	17	17
10.45	33.68	75.5	4.74	17	17
11.00	33.62	75.1	4.51	17	17
11.15	33.41	77.7	4.75	17	17
11.30	33.21	76.3	4.37	17	17
11.45	33.11	73.9	4.51	17	17
12.00	33.04	75.0	4.51	17	17
12.15	32.95	76.7	4.48	17	17
12.30	32.89	75.5	4.5	17	17
12.45	32.81	73.7	4.45	17	17
13.00	32.78	75.1	4.5	17	16
13.15	32.71	74.4	4.26	16	16

13.30	32.67	76.3	4.65	16	16
13.45	32.72	77.6	4.65	16	16
14.00	32.78	76.7	4.48	16	16
14.15	32.66	77.1	4.55	16	16
14.30	32.77	77.4	4.54	16	16
14.45	32.76	77.8	4.52	16	16
15.00	32.89	76.0	4.49	16	16
15.15	32.99	76.6	4.75	16	16
15.30	33.00	74.6	4.5	16	16
15.45	32.85	75.3	4.48	16	16
16.00	32.67	75.5	4.46	16	16
16.15	32.59	76.1	4.47	16	16
16.30	32.51	76.3	4.5	15	15
16.45	32.36	77.3	4.5	15	15
17.00	32.30	75.2	4.44	15	15
17.15	31.71	69.8	3.85	15	15
17.30	30.96	69.4	3.65	15	15
17.45	30.76	70.5	3.64	15	15
18.00	30.86	72.1	3.79	15	15
18.15	30.82	71.7	3.76	15	15
18.30	30.76	71.3	3.75	15	15
18.45	30.67	73.2	3.8	15	15
19.00	31.97	69.3	3.79	15	15
19.15	32.22	68.2	3.76	15	15
19.30	32.35	69.3	4.01	15	15
19.45	32.44	68.3	3.88	15	15
20.00	32.35	67.9	3.6	14	14
20.15	32.22	69.3	4.04	14	14
20.30	32.36	68.6	3.92	14	14
20.45	32.63	69.5	4.03	14	14
21.00	32.85	69.3	4.05	14	14
21.15	33.30	69.9	4.12	14	14
21.30	33.86	69.5	4.25	14	14
21.45	34.24	68.3	4.25	14	14
22.00	34.32	67.7	4.24	14	14
22.15	34.81	66.6	4.09	14	14
22.30	35.47	60.6	4.08	14	14
22.45	35.93	61.6	4.48	14	14
23.00	36.18	61.5	4.26	14	14
23.15	36.25	61.9	4.24	14	14
23.30	36.02	62.5	3.95	14	14
23.45	35.66	62.8	3.92	13	13

2018.04.27; 00.00	35.17	63.5	4.06	13	13
0.15	34.59	60.2	3.95	13	13
0.30	34.34	63.1	3.92	13	13
0.45	34.10	63.9	4.06	13	13
1.00	34.89	60.9	4.02	13	13
1.15	35.60	60.6	4.2	13	13
1.30	37.67	55.4	4.13	13	13
1.45	40.61	49.2	4.35	13	13
2.00	42.67	44.0	4.1	13	13
2.15	42.57	45.3	4.45	13	13
2.30	40.47	47.5	4.23	13	13
2.45	37.67	52.8	4.05	13	13
3.00	37.74	53.3	4.21	13	13
3.15	38.85	50.6	4.02	13	13
3.30	39.09	49.0	4.09	13	13
3.45	38.42	50.7	4.06	13	13
4.00	34.67	57.0	3.76	12	12

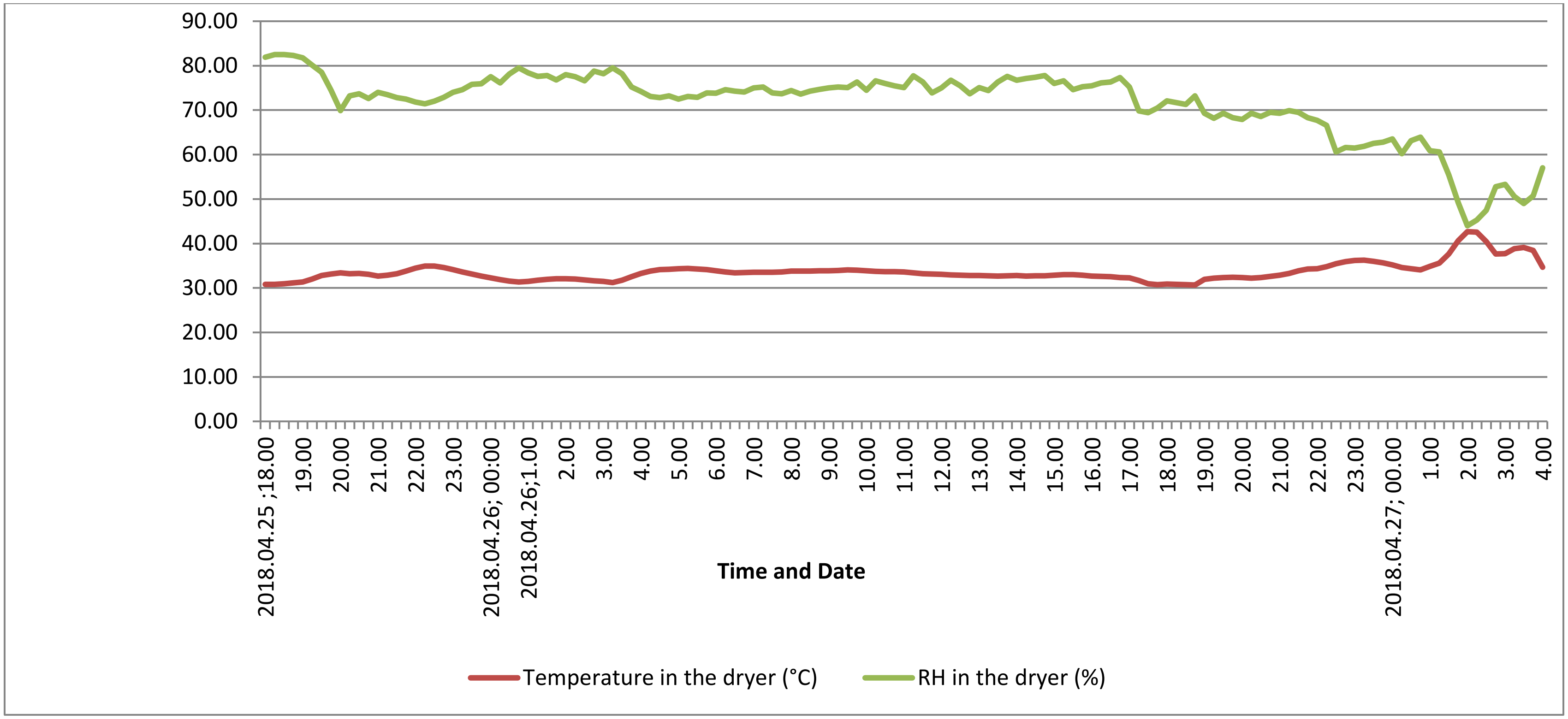

Fig.04- Test B; Trolley No 11; Variation of temperature and humidity in the dryer when the dryer operate on batch mode