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ASSESSMENT OF ON-FARM TRAVEL CHARACTERISTICS OF SMALL SCALE FARMERS IN IBADAN, SOUTH-WESTERN NIGERIA

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ABSTRACT

Transport needs of the farmers have not been properly quantified, most importantly on the farm which is the main hub of his activities. A study was conducted to assess on-farm travel characteristics of small scale farmers in Nigeria during farming activities. On-farm movement parameters such as working speed, workrate, field efficiency, power consumption and distance travelled were evaluated for some farm operations. The working speed during planting of maize and fertilizer application (manual) were both 0.088 m/sec; bed construction had a working speed of 0.013 m/sec. The workrate of planting operation was 0.044 ha/hr while bed making operation had a workrate of 0.0062 ha/hr. The results showed that operations like bed construction, ridging and weeding which were more tedious operations had lower workrate, working speed and travel distance compared to the less tedious operations like planting and fertilizer application. Also more power was consumed for ridging and bed construction than planting or fertilizer application.

Keywords: Rural farmers, On-farm movement, Working speed, Workrate, Power consumption.

INTRODUCTION

Transportation relates to the conveyance of people, goods, etc. to move from one location called the origin to another location called the destination. It enables people to reach their important needs and services such as food, shelter, health and education. (Adeoti, 1995).

Farm transportation, on the other hand, is for movement of farm inputs such as seeds, fertilizer, feed etc. and output as well as farm operators between the farm and town. It is for the development of agriculture which is the main industry in the rural areas of Nigeria (Mijinyawa and Adetunji, 2005). Farm transportation enhances the capacity and effectiveness of farmers. It also raises productivity in such a way that income increases for the farmers.

Farming areas are mainly in the rural areas and as such transportation is more important in the rural than the urban areas. The real farmers are peasants in their rural areas and they are the major producers of food consumed in the urban areas.

Components of farm transportation in agricultural production are off-farm and on-farm movement. The former refers to movement of the farmer between the farm, village and storage points or market while the latter refers to farmers movement during farming operations. On-farm movement is characterized by small load size depending on the operation and small distances at a time which may later add up to several kilometers per day. (Adeoti, 1995).

Farmers movement within the farm cannot be ignored for the development of any farm. The farmer moves during operations like planting, ridging, fertilizer application, weeding, harvesting and processing. During these movements, the farmer expends a lot of power.

Transportation needs have not been properly assessed and the assessment of farmers needs must start on the farm which is the main hub of his activities.

The objective of this work is to study the on-farm movement characteristics of small scale farmers by quantifying their movement in terms of working speed, workrate, efficiency in terms of time, rate of power consumption and total distance traveled during some farming operations. There is need for quantified information to facilitate research and development to improve transport needs of farmers right on his farm, where farming activities takes place.

MATERIALS AND METHODS

In order to characterize the on-farm movement of farmers, the speed, workrate and field efficiency were determined. The time spent operating and the distance covered within that time duration was used in calculating farmers working speed. The distance a farmer covered for each row was measured and multiplied by the width of each row to estimate size of field. Workrate was determined by calculating the size of the field covered from the number of rows and the total length of rows worked on at a certain time.

***Field Performance Evaluation*:**

The field performance of any farmer is usually in terms of the workrate and field efficiency. The effective field capacity (effective workrate) is the actual rate of area covered by a farmer or machine based upon the total time. Workrate is expressed in hectares per hour (ha/hr) (Kepner *et al.,*1978). Field efficiency for machines is the ratio of the effective field capacity to the theoretical field capacity expressed in percentage. It includes the time lost in the field and of failure to utilize the full width of the machine (Kepner *et al.,* 1978). For this study, most farmers effective field capacity depends on the area of the field covered based on the time taken or used per hour.

$$C = \frac{A}{Tt} \qquad \text{(i)}$$

Where C = Workrate
A = Size of field covered (ha)
Tt = Time taken (hrs)

C is in ha/hr

To evaluate field efficiency of a peasant farmer relying on simple hand tools, the field time efficiency can be calculated using the relation.

$$Ef = \frac{Tt}{Tt + tR} \qquad \text{(ii)}$$

Where *Ef* is the Efficiency in terms of time (%)
Tt is the total time spent operating (hrs)
tR is the resting time or non-operating time (hrs)

Rest Period Evaluation: Many agricultural activities demand higher rates of energy consumption. Rest periods are very necessary. The rate of energy consumption exceeding 250-300W cannot be sustained for long (Carruthers and Rodriguez, 1992). Rest periods allow the body to recover. Rest period was evaluated from the relation by (Carruthers and Rodriguez, 1992) which states thus:

$$tR = \frac{60(1-250)}{P} \qquad \text{(Minutes per hrs work)} \qquad \text{(iii)}$$

Where tR = required resting time
P = actual power or rate of energy consumption (W)

The total resting periods were added, quantified and used to determine the rate of power consumed by the farmer for a specific operation.

Data Collection

The method used to collect data was by directly observing the farmers while performing the farming operations. They were located in Ibadan, southwestern part of Nigeria.

Computation of Travel Parameters

This was carried out to establish the basic on-farm travel characteristics. The parameters are:

Trip distance Distance from the beginning of the rows to the end in metres.

Trip time: Time taken to cover one row or time spent from the beginning of a row to the end of the row while operating measured in minutes.

Speed: Distance covered per unit time of a particular row covered measured in m/sec.

Effective field capacity: Actual workrate of the farmer or number of hectares he can operate on in one hour

Efficiency in terms of time: This was determined from the data collected taking into consideration the total time spent operating and the total time spent on the whole field. ie the operating time with non-operating time

Rest periods: This was evaluated from equation iii.

Data Analysis: Data collected were analyzed by finding the means of travel parameters and the correlation test used for comparism of means between age groups of farmers.

RESULTS AND DISCUSSION

Forty-three farmers were assessed during this study in Ibadan, southwestern part of Nigeria in 2006. Some operations were carried out by teenagers while some were by adults or both. Farm operations carried out by them include ridging, bed construction, planting, fertilizer application and weeding. For ridging operation, ten adults and five teenagers were assessed. For bed construction, all seven farmers assessed were adults while the planting, fertilizer application and weeding activities were done by sixteen adults and five teenagers except for fertilizer application that was only done by adults. The crops planted were maize at a spacing of 75 cm by 25 cm intercropped with pepper and some vegetables.

Ridging operation

Fifteen farmers were assessed for ridge making, ten were adults and five were teenagers. During ridging operation, on the average a farmer worked continuously for 274 mins. with a rest period of 15 minutes per hour for a day's work. (Table 1). He ridged 0.033 ha at a working speed of 0.017 m/sec (0.06 km/hr) compared to normal off-farm walking speed of 3-5 km/hr (Carruthers and Rodriguez, 1992). At the farmers working speed the farmer covered a total distance of 0.27 km during the operation. The farmers overall field time efficiency was 94.8 %. During the ridging operation, the farmer had an estimated power consumption of 347 watts. In a review carried out by Aregbe (1994), he reported that using hand hoe for ridging the average workrate of the farmers was 0.0041 ha/hr. the average field efficiency of hand hoe was within the range of 80.5-92 % while the workrate was within the range of 0.0023 – 0.0056 ha/hr. He also reported that the largest area of land cultivated by one of the farmers was 0.031 ha.

Comparing the means of Adult and teenagers, the study showed that adults covered a higher field size, working speed, workrate than teenagers but there is an inverse correlation between the adults and the teenagers (Table 1). This can be attributed to their level of experience and expertise.

Bed construction

Beds are made for crops like tomato, pepper and okra. All the farmers used the simple hand hoe for the activity. Seven adults were assessed during the bed construction. On the average, a farmer worked for 266 mins. (4 hrs 26 mins.) in a day and during this period a field size of 0.026 ha was covered at a working speed of 0.013 m/sec. A low value compared to the normal walking speed of man. During this operation, the farmer rested for 24 minutes. Based on the farmers working speed, he covered a total of 210 m and had a workrate of 0.0062 ha/hr. (Table 2)

During the activity, the farmer had an estimated power consumption of 429 Watts. His efficiency in terms of time was very high

Table 1: Mean Travel Parameters for Ridging Operation

		Mean	
Parameter		**Adult**	**Teenager**
Field size (ha)		0.037	0.024
Average speed (m/sec)		0.019	0.013
Workrate (ha/hr)		0.009	0.005
Total time spent operating (mins.)		259.29	307.33
Rest period (min.)		17.43	9.67
Total distance moved (km)		0.284	0.230
Field efficiency (%)		93.871	97.033
Rate of power consumption (Watts)		366.886	298.933
Correlation coefficient			
Field size	-0.969		
Average speed	-0.727		
Work rate	-0.803		

Table 2: Mean travel parameters for Bed-Making Operation

Parameter		Mean
Field size (ha)		0.026
Average speed (m/sec)		0.013
Workrate (ha/hr)		0.006
Total time spent operating (mins)		265.80
Rest period (min)		24.00
Total distance moved (km)		0.210
Field Time efficiency (%)		91.70
Rate of power consumption (Watts)		429.10
Correlation coefficient		
Power consumption and rest period	0.924	

compared to a machine (91.7%) because there were no time loss due to equipment breakdown and turning.

Planting operation

Sixteen adults and five teenagers were assessed for planting, fertilizer application and weeding operation respectively. The same piece of land was used for the three activities. On the average, a farmer worked for 88 minutes with a rest period of 7 minutes, planting being a very laborious and time consuming operation (Kazmeinkhahl,2007). During the operation, a farmer planted on field size of 0.059 ha at a working speed of 0.088 m/sec (0.32 km/hr) compared to 3-5 km/hr in off-farm walking speed (Carruthers and Rodriguez, 1992).At the farmers working speed, he covered a distance of 400 m during the operation and a workrate of 0.044 ha/hr. the overall field efficiency was 91 %. This is rather high due to the low rest period compared to the total time spent while operating. (Table 3)

The estimated power consumption of the farmer during planting was 289.5 watts and this is within the specified range of (Aregbe, 1994).

Fertilizer Application

From Table 4, the average farmer worked continuously for 86 minutes with a rest period of 4 minutes. This rest period was low due to the fact that there was no interruption during the fertilizer application. On the average, a farmer covered a field size of 0.058 ha with a working speed of 0.32 km/hr. At this working speed, he covered a distance of 460 m with a field time efficiency of 96%. This value was high as a result of the low rest period. The farmer had a workrate of 0.04 ha/hr with an estimated power consumption of 267.3 Watts.

Weeding operation

On the average, a farmer covers a field size of 0.033 ha at a working speed of 0.016 m/sec., having a workrate of 0.007 ha/hr and resting for 14 minutes out of a total operating time of 248 minutes. The farmer had a field time efficiency of 94.8 % A mean travel distance of 230 m was covered at a power consumption rate of 333.2 Watts. Comparing the adults and teenagers, adults consumed more power than the teenagers and had higher workrate though there was no significant difference between them (Table 5). Using the hand hoe for weeding requires the farmer bending and this posture consumes considerable energy between 300 Watts to 1000 Watts especially when the weed density is high. (Goel *et al.,* 2008)

Table 3: **Mean travel parameters for Planting Operation based on Age group**

Parameter	Mean Adult	Mean Teenager
Field size (ha)	0.062	0.051
Average speed (m/sec)	0.085	0.094
Workrate (ha/hr)	0.042	0.047
Total time spent operating (mins)	97.71	65.33
Rest period (min)	9.29	2.33
Total distance moved (km)	0.414	0.353
Field Time efficiency (%)	88.77	96.27
Rate of power consumption (Watts)	301.99	260.23

Table 4: **Mean travel parameters for Fertilizer Application**

Parameter	Mean
Field size (ha)	0.058
Average speed (m/sec)	0.088
Workrate (ha/hr)	0.040
Total time spent operating (mins)	86.00
Rest period (min)	3.80
Total distance moved (km)	0.460
Field Time efficiency (%)	95.90
Rate of power consumption (Watts)	267.30

Table 5: Mean Travel parameters for Weeding operation based on Age Group

	Mean	
	Adult	**Teenager**
Field size (ha)	0.036	0.027
Average speed (m/sec)	0.018	0.012
Workrate (ha/hr)	0.0068	0.0063
Total time spent operating (mins)	241.63	260.75
Rest period (min)	15.38	12.25
Total distance moved (km)	0.26	0.17
Field Time efficiency (%)	94.31	95.73
Rate of power consumption (watts)	340.6	318.4

Figures 1 – 6 show the mean values of the measured parameters during the different farming operations.

The planting and fertilizer application operation both had the same working speed (Fig.1). Both operations had the highest working speed and workrate compared to operations like ridging, weeding and bed-making which are more tedious operations. (Figs 1 and 3) The largest size of field covered by both operations is 0.059 ha (Fig. 2). The values are high when compared to other operations such as ridging, bed construction and weeding. This may be attributed to the fact that planting and fertilizer application are less tedious operations. Bed construction operation had the smallest size of field covered. This is expected taking into consideration the tediousness of the activity. During bed construction operation, there is a linear relationship between power consumption and rest period (R^2= 0.924). (Table 2).

When compared to bed-making operation that had the lowest workrate it is noted that workrate of a farmer depended on the farmers working speed and width of row he could cover on a trip. The higher the speed of farmer and width of row covered, the higher the workrate.

The operation with the longest travel distance covered was fertilizer application (460m) followed by planting (400 m) (Fig. 4). Bed construction had the shortest travel distance and this was due to the low working speed, low workrate and tediousness of the operation.

The operation with the highest value of rest period was bed-making followed by ridging and weeding (Fig. 5). Rest period was high because the farmer needs some time to rest after working tirelessly on an operation that consumes much energy.

Bed-making had the highest estimated power consumption of almost 430 Watts. Ridging and weeding operations also had an estimated power consumption of 347 and 333 Watts respectively. It was also noticed that planting and fertilizer application had the lowest values for estimated power consumption (Fig. 6).and this could be due to the low resting period and less tedious the operations are.

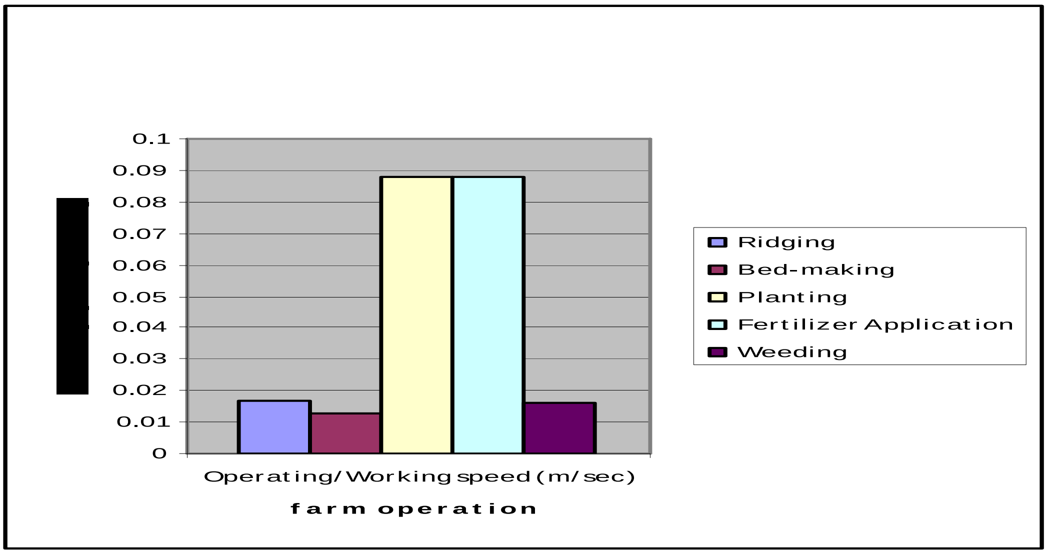

Figure 1: Mean working speed (m/sec) of operation

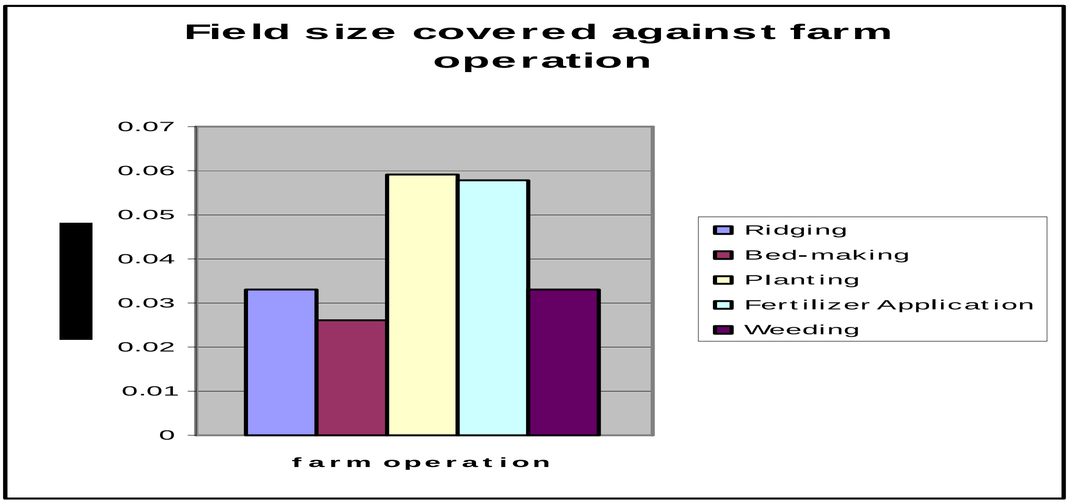

Figure 2: Field size covered against farm operation

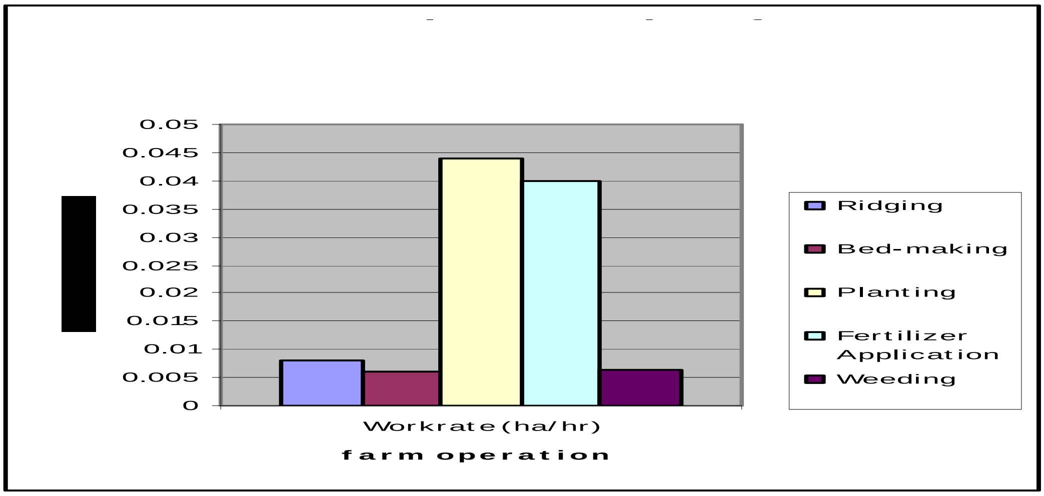

Figure 3: Mean workrate against farm operation

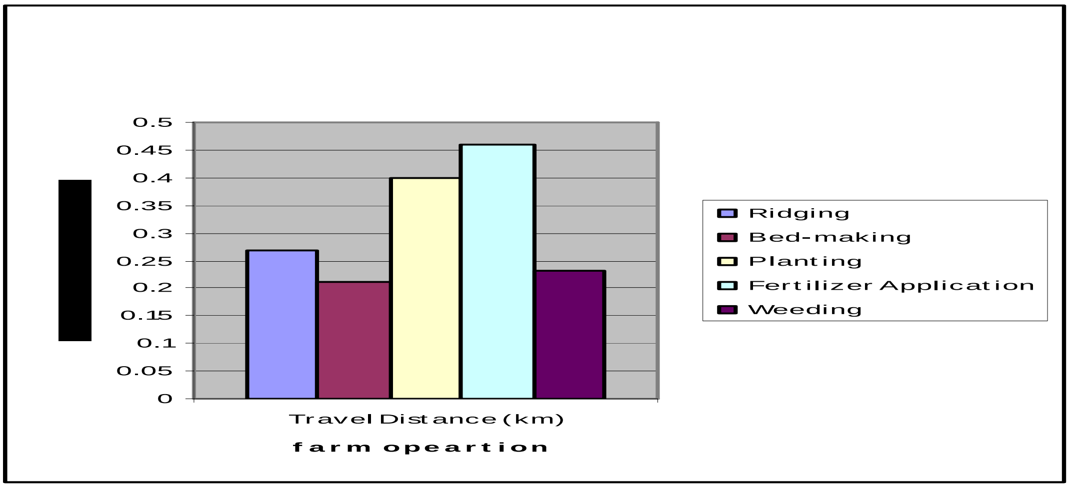

Figure 4: Mean travel distance against farm operation

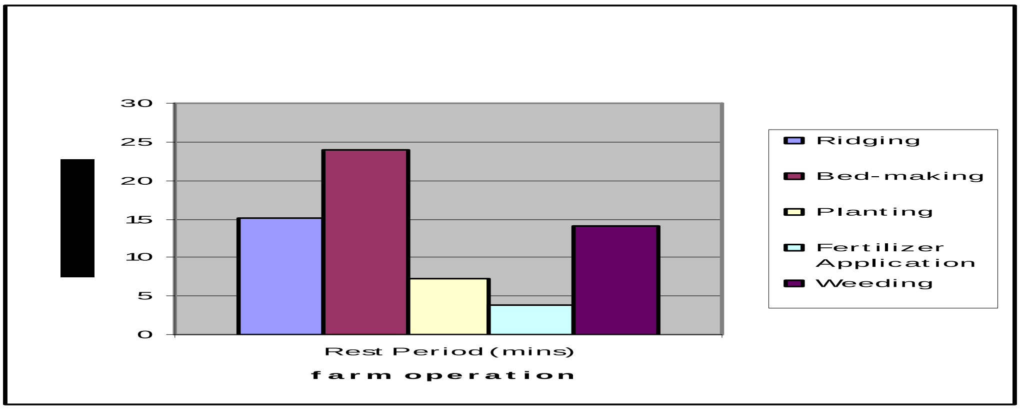

Figure 5: Mean rest periods against farm operation

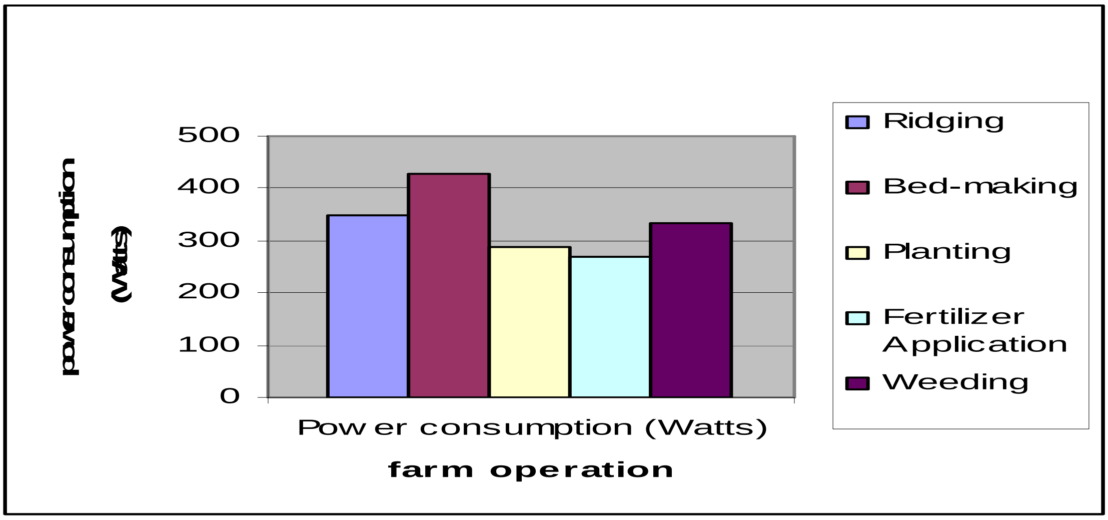

Figure 6: Mean power consumption against farm operation

CONCLUSION

This work accessed the transport needs of farmers right on the farm where their main activities take place. This shows the problems they encounter in terms of on-farm movement. The information got from this work can be of tremendous advantage for the development of simple machines for farmers considering their working speed, workrate and field coverage

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OPTIMIZING HOT DIP GALVANIZING OPERATIONS OF STEEL SHEETS FOR BETTER QUALITY

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ABSTRACT

Hot dip galvanizing operations were conducted in the laboratory for steel sheets of 0.20 mm, 0.60 mm and 1.0 mm thicknesses. The operations were carried out using 99.8% zinc with small amounts of aluminium addition at 450°C for 1.0 min immersion duration at withdrawal speeds of 3 m/min, 4 m/min and 5 m/min. Steel plates were withdrawn into a clean area in an open space where they were rapidly cooled. The quality of the galvanized coatings produced was evaluated by their appearance, lustre and uniformity. The results obtained showed varying quality parameters for different thicknesses. Gauges 18, 22 and 28 steel sheets had best quality in terms of coating lustre and uniformity at respective withdrawal speeds of 3m/min, 4 m/min and 5 m/min. The differences in the heat capacities of different gauges led to their different responses in cooling time which accounted for the results obtained.

Keywords; Temperature, withdrawal speed, coating, uniformity, quality.

INTRODUCTION

Protection of steel from rust through hot dip galvanizing is an age long activity. Many methods of protecting steel from corrosion are possible. Such methods are painting, electroplating, alloying addition (for example, nickel or chromium), cathodic protection (using sacrificial anodes or impressed currents) or by coating with a thin layer of corrosion resistant metal. Many current corrosion control measures use coatings, conversion layers, material selection, design, cathodic protection, inhibition and environment alterations among other control measures (Lawal *et al.,* 2006, Lee and Charackhs, 1993 and Abiola and Oforkar, 2002). A galvanized steel sheet includes a galvanized coating layer. The zinc phosphate or chromate coating layer contains from about 0.5 to 10.0% by weight of magnesium, from about 0.1 to 2.0% by weight of nickel, and from about 0.5 to 8.0% by weight of manganese (US Patent 6322906, 2001). The performance of galvanized coating is known to depend to a large extent upon the nature of the environment to which it is exposed. However, for any specific exposure condition the thickness of galvanized coating is the most important factor determining its life of corrosion protection (Wall, 1989). Galvanized coating comprises an outer 'pure' zinc layer and several inner alloy layers of iron and zinc inter-metallic phases, the layers becoming successively richer in iron with depth. The role each of these layers plays in the overall corrosion performance of the