

Design of Solar Panel for 1.5 Hp Nano Coated Motor Used in Ball Mills for Producing Nano Powders in Pyro Industries in Sivakasi

D. Edison Selvaraj,
A. Venkatesan,
A. Sivakumar,
Assistant Professor / EEE
Panimalar Engineering College
Chennai, India.

D. Benson Celix,
B.E – II Year / EEE,
Panimalar Engineering
College,
Chennai, India.
bensoncelix191@gmail.com

S. Suthir,
Research Scholar,
Manonmaniam Sundaranar
University and
Assistant Professor,
Panimalar Engg. College,
Chennai, India.

T. Blessline Ponmani,
G. Sivakumar,
Assistant Professor / Chemistry
Panimalar Engineering
College,
Chennai, India.

J. Ganesan
Assistant Professor / EEE
Sree Sowdambika College of
Engineering
Aruppukottai, India.
Powergrid4@gmail.com

S. Dwarakesh,
B.E – II Year / Mech,
Panimalar Engineering
College,
Chennai, India.

K. Joiada Sheloni Rachee,
BE – IV Year/EEE,
Panimalar Institute of
Technology
Chennai, India.

Abstract: This paper deals with the design of nano coated motor used in ball mills used for producing nano powders in pyro industries in Sivakasi. This paper also briefs about the profile of industries and administration of Virudhunagar district. A brief history of Virudhunagar district was also discussed. This paper deals with the industrial application of nano coated motor used in the preparation of nano powders used in pyro industries located in Sivakasi. Design of solar panel for 1.5 Hp nano coated motor was given in nice manner for the understanding of young researchers to design the solar cells for the nano coated motor. These nano coated motors were used in pyro industries for producing nano powders in ball mills in Sivakasi.

Keywords: Solar panel, nano coated motor, pyro industries, ball mills, Sivakasi, Virudhunagar district. Enamel,

1. INTRODUCTION

This paper deals with the industrial application of nano coated motor used in the preparation of nano powders used in pyro industries located in Sivakasi. Particle sizes of powders used in pyro industries were in nano size. So, pyro industries were called as Nano pyro industries. Balls mills were used to produce Nano pyro powders. Induction motors were used in Ball mills. Nano coated windings were used in Induction motor and hence, these motors were called as nano coated induction motors. These nano coated induction motors were operated by solar power. Hence, these kinds of motors were called as solar power operated Nano coated induction motor. These motors can be used in ball mills to produce nano pyro powders in pyro industries in Sivakasi. Hence the article was

named as “Solar power operated Nano coated Induction motor used in Ball mills in Nano pyro industries in Sivakasi”.

Sivakasi was a mega industrial hub in Virudhunagar district. Virudhunagar district was carved on 15th March 1985 by trifurcation of the composite Ramanathapuram district with head quarters at Virudhunagar. The district lies between 55.00 Degree and 77.00 Degree of the eastern longitude and between 9.00 Degree and 55.00 Degree of the northern latitude. It has an area of 4243 Sq Km and is bounded on the west by Kerala State, on the north by Madurai and Sivaganga district, on the east by New Ramanathapuram district and on the south by Tirunelveli and Tuticorin districts.

Virudunagar is a small town located at a distance of 45 Kms South-West of Madurai. This place was once referred to as

'Virudupatti'. In the beginning of 20th century A.D., Virudupatti was one among the six important places of Ramanathapuram District. Due to the rapid growth in the field of Trade and Education, it was renamed as 'Virudunagar' on 29th October 1923. The term 'virudu' means 'Award' in Tamil. The people of this community migrated to improve their business status and settled in Virudunagar during 19th century A.D. Virudunagar exports all kinds of oil to Dubai and Srilanka and also exports Cotton, chilli, spices, cardamom to USA and Singapore. Virudunagar is a famous business centre without markets. The Business people of Virudunagar play an important role in price fixation of consumer products. Hence there is a popular saying, "virudunagar produces nothing but controls everything".

In 1985, the erstwhile Ramanathapuram District was trifurcated to create the districts of Ramanathapuram, Pasumpon Muthuramalinga Thevar Tirumagan (later renamed Sivaganga) and Kamarajar District (later renamed Virudhunagar District).

The District headquarters is Virudhunagar town. It covers an area of 4232 sq. km and is divided into 8 taluks, namely Aruppukkottai, Kariapatti, Rajapalayam, Sattur, Sivakasi, Srivilliputtur, Tiruchuli and Virudhunagar. On 3rd March 1996, Sivakasi taluk was created separating the firkas of Sivakasi, Edirkottai and Salwarpatti from Sattur taluk and Mangalam firka from Virudhunagar taluk. In 31st August 1998, Kariapatti taluk was formed by separating Kariapatti, Mudukkankulam and Kalkurichi firkas from Aruppukkottai taluk. Mallanginar firka, the 4th firka of the taluk was carved out of Kalkurichi firka. The District is divided into two Revenue Divisions comprising four taluks each. The Aruppukkottai Revenue Division comprises Kariapatti, Tiruchuli, Aruppukkottai and Virudhunagar taluks, and Sivakasi Revenue Division of Sattur, Sivakasi, Srivilliputtur and Rajapalayam taluks.

According to the 2011 census Virudhunagar district has a population of 1,943,309, roughly equal to the nation of Lesotho or the US state of West

Virginia. This gives it a ranking of 242nd in India (out of a total of 640). The district has a population density of 454 inhabitants per square kilometre (1,180 /sq mi). Its population growth rate over the decade 2001 - 2011 was 10.96 %. Virudhunagar has a sex ratio of 1009 females for every 1000 males and a literacy rate of 80.75 % [2]. It is 44.39 % urbanized. Majority of the population are involved in Industries and agriculture. The total area of Virudhunagar District is 3445.73 km.

The climate is generally hot and dry with a low degree of humidity. The District receives scanty rainfall. The average annual rainfall is only 987.7 mm. The frequent drought caused by the failure of the monsoon adversely affects the dry crops depending upon rain fed tanks for irrigation. Soil is predominately black soil.

Virudhunagar has rich mineral deposits of lime kankar and granite also. The lime and limestone deposits are concentrated in Pandalkudi, Chettipatti and Velayudhapuram villages of Arupukkottai taluk and Cholapuram and Perumalpatti of Rajapalayam taluk and Gopalapuram, Kangaseval and Vertrilaiyurani of Sattur taluk. Likewise, kankar deposits are found abundant in Kilavarneri and P. Pudupatti in Kariapatti blocks of Arupukkottai taluk. Granite deposits are also found in

Thiruthangal in Sattur taluk and Pillaiyarkulam in Srivilliputtur taluk.

The forests are found on the eastern slopes of the Western Ghats. Only 6.3% of the total geographical area of the district is under forests. Many rare and endemic varieties of flora and fauna are found along the mountain slopes. A wildlife sanctuary, spread over 480 sq. kms was established in 1989 at Shenbagathopu in Srivilliputtur taluk. The forests of Alagarkoil valley in Srivilliputtur taluk and Saduragiri are known for rare medicinal plants. The medicinal value of 275 plants has been recorded and reported. The forests host a rich variety of orchids and ferns.

The district has got 3 revenue divisions, 7 municipalities, 11 blocks and 9 taluks respectively. The district is endowed with a semi arid tropical climate with an average rainfall of 985.7 mm. The predominant soil type is black loamy. This type of soil is found common in Sattur, Srivilliputtur, and Aruppukkottai blocks.

Existence of Industrial estate attracts investment opportunities. The Tamil Nadu Small Industries Development Corporation (SIDCO) is the agency for establishing and maintaining industrial estates for tiny and small-scale industries in this district/state. Two Industrial Estates are functioning at Virudhunagar and Rajapalayam. A Cooperative Industrial Estate is also functioning at Sivakasi. SIDCO has also constructed Tiny Industrial Sheds at Watrap, Kariapatti and Thiruchuli.

Virudhunagar district is known for concentration of multiple enterprises in different part of the district. Each block is unique in nature. Concentration industries like Match, Fireworks, Printing, Oil Extraction, readymade garments, Brick Making, Surgical cotton, textile products, cement, lime based products, rice mill, paper products, food industries, tin containers, gold jewellery making in different parts of the district offer multiple intervention for further development. It attracts the attention of the policy makers and reaches to anchor the industrial development in a balanced manner across the district. Cotton is a major commercial crop of the District and the cotton industry therefore occupies an important place in the economy. Rajapalayam is the chief centre for spinning mills and ginning factories. Surgical cotton and bandage cloth are manufactured here. Textile mills in the produce a variety of cotton yarn and valued added textile products. The District has huge deposits of limestone and gypsum. It paves the way to establish lime based and cement industry Tamil Nadu Cements – a Public Sector undertaking at Alangulam and Madras Cements – a Private Sector undertaking at Thulukkappatti are two large cement producing units situated in this district.

Sivakasi and Sattur are known for the match industry. There are over 4500 match unit concentrated in this district giving employment to more than lakh plus people. There are nearly 450 fireworks factories giving direct employment, to about 40,000 workers and about 1 lakhs indirect such as paper tube making, Wire cutting, Box making sale distribution in the country side. The market for fire works is likely to grow at the rate of 10% per annum. The annual output is over 50,000 tones, and turn over (at factory cost) around Rs. 350 crores according to industrial sources.

Explosives for blasting are also manufactured here. Over 70% of the total production of matches and fireworks in India is

manufacture in Virudhunagar District. A large percentage of crackers are exported. Sivakasi, renowned the world over for its printing, Litho Presses, offset printing machines of which is the second largest number in the world, next to Gutenberg, a city in Germany. Around 450 printing presses including offset & flexo types are located in and around Sivakasi.

The printing industry was originally established to supply labels for the match and firework industries. Soon the industry developed and diversified into other areas of printing like books, posters, greeting cards and diaries. Sivakasi now offers state of the art, world class printing facilities. Sattur town was once very famous for fountain pen Nib manufacturing industries. More than 2000 families were involved in this industry. But during the recent times, usage of fountain pen has come down to larger extent and hence the industry is in declining trend. This industry, which was once the bread winning industry of the town has almost, vanished now.

Sundaram Fasteners and Brakes India Ltd, private sector enterprises of the

TVS group are located at Aviyur and Kanjanaiyakampatti in Kariapatti taluk. The former manufactures high density bolts and nuts while the latter manufactures automobile brakes. There are 19335 registered small scale industrial units as on 31 December 1999 engaged in the manufacture of a very wide range of products. Cottage and village industries are dispersed throughout the rural areas. Some common cottage industries are: making of boxes and other articles from Palmyra leaves, metal artifacts fashioned from copper and brass, and aluminium vessel manufacture for domestic use. Gold jewelry making enterprises are concentrated in Virudhunagar, Rajapalayam, Srivilliputtur and Aruppukottai. The Traditional lock making enterprises are situated in Rajapalayam town. Virudhunagar, Rajapalayam, Sattur, Watrap, Aruppukottai and Kamudi are important centres for wholesale and retail trade. Cotton, groundnut, chillies and spices are the main agricultural goods of trade. Matches, crackers, cement and textiles are marketed both within and outside the State. Two warehouses at Virudhunagar and Rajapalayam offer facilities for storage of food grains, spices, pulses, chillies, jaggery and cotton.

An analysis of the growth of small scale sector reveals that the significant change in structure and pattern of the industrial development have taken place within the small scale sector in the district. Promising changes in structure and pattern of industries have made a noticeable impact on the production front.

1.1 Strength

- a) Widened highway from Chennai to Kaniyakumari.
- b) Widened road from Madurai to Tuticorin
- c) Completion of Sethu Project.
- d) Extended Port in Tuticorin
- e) Nearest Airport at Madurai – 45 Km.
- f) Availability of skilled labours.
- g) Formation of SIPCOT & SEZ

h) Dispersal of different types of Micro, small and medium clusters in different location of the district

i) 5 TNEB substations are yet to commence

1) Pulvaikarai

2) Sulakkarai

3) Nenmeni

4) Sukaravarpatti

5) Nallamanaickenpatti.

j) SH 42 were converted into NH. 2000 Crores were sanctioned for the extension of two way road into four ways.

1.2 Weakness

a) Non – availability of Technical person

b) Lack in Technical adoption

c) Competition from abroad like china etc.

d) Low infrastructure

e) Low rail connectivity between different states of India

1.3 Opportunity

a) Availability of natural resources

b) Diverged business operation

c) Availability of Manpower

d) Developed IT field

e) Better export chance

f) Availability of waste land

g) Near to Tuticorin Port

h) Strong Presence of Enterprising People

i) Extension of Srivilliputhur to Parthibanoor road as four ways

1.4 Threat

a) Tough competition

b) Non – availability of credit

c) Non presence of big industrial estate

The district is not witnessing the strong presence of Medium scale enterprises. There are 9 large scale enterprises in this district. They are mostly engaged in manufacturing Auto component, cotton and textile products, cement, and surgical cotton.

1.5 Major Industrial Groups in Virudhunagar District

1. TVS Groups
2. RAMCO Groups
3. Jeyavilas Groups
4. Naatchiyar Groups
5. Arumuga Group of Industries
6. Subburaj Cotton Mills Group
7. Standard Group of Industries
8. Arasan Group of Industries
9. Cement factory

1.6 Service Enterprises

Virudhunagar district is witnessing a strong presence of service enterprises and foot loose industries. Major contribution has emerged from service enterprises. The following service enterprises are having visible presence in Virudhunagar regions: Hotel, Hospitality enterprises, Hospital, restaurant, Industrial consultancy,

educational instructions ,web site developing, two - 4 wheelers servicing and repairing, tutorial, BPO, private telephone, Marriage Bureaus, electric and electronic goods servicing and repairing, Travel Agency, Gas Agency, Construction consultancy, Marriage items hiring, industrial Testing Labs, Advertising Agencies, Marketing Consultancy, Typing Centers. Desk Top Publishing, internet Browsing/Setting up of Cyber Café Auto Repairs, Services, Garages, Laundry & Dry, X-Ray clinic, Cleaning, Animal dispensary, Weigh Bridge, Blue Printing and enlargement of drawing/designs facilities, Operation of Cable TV Network, Beauty Parlours and Crèches.

1.7 Potential areas for service industry

BOP, Hotel, Hospitality enterprises, Hospital, IT enabled, Documentary Films on themes like Family Planning, Social Forestry, Energy Conservation, and Commercial Advertising, industrial Laundry , Tailoring., Pathological lab, integrated diagnostic centre, Sub-contracting Exchanges (SCXs) established by Industry Associations, Beauty Parlors and Crèches, fitness centre for men and women, Glass engraving, Ladies and gents Hostel , House Keeping and Office and equipment maintenance , Interior decoration, Industrial design and layout making. Logistic centre, Material Handling, Metal coating, Office Automation, Parcel servicing and private carrier, upholstery , Power System maintenance, Manpower agency, Weighing bridge repairing and maintenance, digital printing, Embroidering and chamki work , repacking of agriculture produce, Glass engraving, multipurpose diagnostic centre.

1.8 Suggestion for Industrial associations from MSME

1. Creation of Common display centre within SIDCO industrial Estate, Industrial Association and DIC.
2. Fund support for undertaking adhoc studies.
3. Skill up gradation – participatory model Industry-Institution – MSME –DI - E & T programs may be allowed to conduct by Industrial association and MSE by themselves.
4. Project specific allocation for introducing hybrid business development for Tribal, Rural and artisan clusters.
5. Scheme for community enterprises in respect of privileged groups and Tribal community.
6. Fund support for establishing Community enterprises at Tribal regions.
7. More support from NSIC, Re introduction of hire / purchasing scheme.
8. PMEGP scheme may be revised and KVIC may be allowed to fund only rural enterprises and State May be permitted to implement the scheme for promoting more MSEs at regional Level.
9. Creating common software for tracing the industrial sickness.
10. Conducting Integrated modular rural development programs.
11. Establishing Business Incubation within the premises of Industrial Estates.
12. Preparation of need based project proposals for establishing Medium scale enterprises.
13. Creation of multiple linkages with educational institutions, R &D centers.
14. Developing forward linkages with user groups.

2. SPECIFICATIONS OF THE MOTOR

The particle size Current – 4.2 A
Voltage – 230 V
Capacity - 1.5 Hp
Speed – 1500 rpm

3. DESIGN OF PV PANEL

The design of solar panel involves the following steps:

1. Load calculation
2. Inverter design
3. Calculation of battery ratings
4. Charge controller efficiency
5. Design of PV panels



Figure 1 Design of solar panel

Consider the motor load having 1.5 Hp.

1 Hp = 746 Watts.

1.5 Hp = 1.5 x 746 Watts = 1119 Watts.

Total Watts of the motor = 1119 Watts.

Total Watts hour of the motor load = 8952 Wh

Consider the motor operates for 8 hours

Inverter rating = $1119/0.8=1397.78$ VA

Power factor = 0.8

Consider inverter efficiency of 93 %

Output of the battery = $8952/0.93=9625.81$ Wh

Consider a battery rating of 12 V, 100Ah

System voltage = 24V

20 Batteries are connected in series to obtain 230V

Depth of discharge of battery = 75 %

Rated Ampere hour of battery considering Depth of discharge
= $0.75 \times 100 = 75$ Ah

Actual Ampere hour of the battery = $9625.81/230=41.85$ Ah

Number of battery = $41.85/75=0.6$ (approx-1 battery)

Considering, the autonomy of 5 days for this case. Hence, the number of strings would be $5 + 1 = 6$. Number of strings = 6

Number of PV panel

Controller efficiency = 0.97

Input to the battery = $9625.81/0.8 \times 0.97=12404.39$ Wh

Battery efficiency = 80%

Number of sun shine hours = 5

System voltage = 230 V

Ampere hour of the panel = $12404.39/230=53.93$ Ah

Ampere rating of PV panel = $53.93/5=10.79$ A

Consider a PV panel of voltage 15V, 5A, 75w

Number of panels in parallel = $10.79/5=2.16$ (approx-3)

Number of panels in series = $230/15=15.33=16$

4. CONCLUSION

This paper dealt with the use of nano coated motor in the pyro industries and design of Solar panel for that nano coated motor which were used in the pyro industries located in Sivakasi. South Tamil Nadu was becoming an important solar hub in the world. Solar power generation units were constructed in South TN for continuous and uninterrupted power supply to the country. Recently, some HVDC cable transmission of power project from Sri Lanka to Madurai grid were under in initial state to get power from Sri Lanka to India in future. Set up of nano Lab is rare, new and uncommon. It is also an emerging technology. Fabrication of powder needs extra machines which are not popular among common people. It will become popular in the coming future. Nano coated motors can bring the following changes in the conventional machine tools:

1. Accuracy and quality of output can be improved
2. Improves the life time of the plant
3. Reduces the maintenance cost

The proposed work can be extended in future as follows:

1. Coating of stator winding of induction motor with enamel filled with various nano fillers such as ZrO₂, ZnO, Al₂O₃, SiO₂, SiC and so on.
2. Testing of nano coated motors – load test, blocked rotor test, no load test, temperature withstanding test
3. Measurement of stator resistance
4. Equivalent circuit parameters
5. Speed control of nano coated motor
6. Comparison of both nano coated motor and normal induction motor
7. Harmonic reduction by using nano fillers
8. Measurement of EMI and EMC
9. Estimation of losses in both motors and its comparison
10. Implementation of solar panel for the nano coated motor.

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6. REFERENCES

- [1] Selvaraj, D. Edison, et al. "Analysis of Efficiency, Thermal Withstanding Capacity and Electromagnetic Interference of Three Phase Squirrel Cage Induction Motor Coated with SiO₂ & TiO₂ nano composite Filled Enamel." International Journal of Science and Engineering Applications 1.1 (2012): 17- 21.
- [2] Edison Selvaraj, D., C. Pugazhendhi Sugumaran, and A. Sivaprakash."Characterization of Electrical and Thermal Properties of Enamel Filled with Carbon Nanotubes." Proceedings of the Third International Conference on Trends in Information, Telecommunication and Computing. Springer New York, 2013.
- [3] Selvaraj, D. Edison. "Partial discharge characteristics of enamel filled with micro and nano composite of siO₂ and TiO₂." International Journal of Science and Engineering Applications 1.2 (2012): 95-101.
- [4] Selvaraj, D. Edison. "Characterization of dielectric properties of the enamel filled with carbon nano tubes for the frequency range of 50 Hz-5 MHz" International Journal of Science and Engineering Applications 1.2 (2012): 102-106.
- [5] Selvaraj, D. Edison, and C. Pugazhendhi Sugumaran. "Comparative Analysis of Dielectric Properties of Enamel Filled with Various Nanofillers such as ZrO₂, Al₂O₃, CNT and ZnO." International Journal of Science and Engineering Applications 1.1 (2012): 51-55.
- [6] Babu, B. Gurukarthik, D. Edison Selvaraj, R. Srinivas, B. Guru Prakash, and R. Vishnu. "Analysis of Relative Permittivity and Tan Delta Characteristics of Silicone Rubber Based Nano-composites." International Journal of Scientific Engineering and Technology , pp.2201-206, 2012.
- [7] D. Edison Selvaraj, J. Ganesan. "Experimental Analysis of Efficiency and Thermal Withstanding Capacity of Three Phase Squirrel Cage Induction Motor Coated with SiO₂ & TiO₂ Nano Composite Filled Enamel", International Journal of Engineering Sciences, Vol (2), No (4), 2013. pp. 115-118.
- [8] Lieutenant Ganesan. J, Jeyadevi.S.Dr, and Edison Selvaraj. D, "Performance Analysis of Single Phase Induction Motor Coated with Al₂O₃ Nano Filler Mixed Enamel" ACEEE International Journal on Recent Trends in Engineering & Technology Vol. 10, No. 1, Jan 2014.
- [9] Edison Selvaraj. D, Pugazhendhi Sugumaran. C, Lieutenant Ganesan. J, Ramathilagam. J, "Analysis of Dielectric and Thermal Properties of Polyamide Enamel Filled with Carbon Nano tubes" International Journal of Nano science, Vol.12, Issue 3, June 2013.
- [10] Lieutenant Ganesan. J, Edison Selvaraj. D, and Ramathilagam. J, "Experimental analysis of Thermal conductivity of enamel filled with micro and nano composite of SiO₂ and TiO₂" International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue 7, pp. 2907-2912 , 2013.
- [11] Lieutenant Ganesan. J, Jeyadevi. S. Dr, and Edison Selvaraj. D, "Reduction of Electromagnetic Interference in Single Phase Induction Motor by coating the winding with Al₂O₃ nano filler mixed Enamel" International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue7, pp. 2913-2916 , 2013.
- [12] Lieutenant Ganesan. J, Edison Selvaraj. D, and Selva Kumar. B, "High Efficiency Induction Motor", International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue 2, pp. 750-754, 2013.
- [13] Lieutenant Ganesan. J, Edison Selvaraj. D, GuruPrakash. B, Vishnu Prakash. R, Muthupandi. E, and BalaKumar. R, "Analysis of Efficiency and Thermal Withstanding Capacity of Single Phase Induction Motor Coated with Al₂O₃ Nano Filler Mixed Enamel", International journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.2, Issue 3, pp. 960-963, 2013.
- [14] Edison selvaraj. D, et.al Applications of Nano Technology in Pyro Industries located in Sivakasi, International Journal of Science and Engineering Applications Volume 4 Issue 4, 2015.
- [15] Ben nett T and Zilo uchain A (2012), "Photovoltaic model and converter topology considerations for MPPT purposes" , Solar Energy 86(7), pg 2029-2040.