FORMAT FOR SUBMISSION OF PROPOSALS UNDER " PROJECT RELATED GRANT (PRG)" PROGRAMME OF DST (GOI)

A. IDENTIFICATION

1. Project title: **CONVERSION OF SOLID HAZARDOUS WASTE TO ECO-ECONOMIC PRODUCTS**

Key words: Solidification, Stabilization, Hazardous waste, Compressive strength, Water absorption, Porosity

2. State : Telangana

3. Broad Area: Location Specific Research & Technology Development (LSR)

4. Duration: 12months (number of months)

5. Total Cost: Rs.5,00,000-00 (Rupees Five Lakhs only)

6. Principal Investigator:

Name: **Dr.P.Saritha**
Department: Civil Engineering Department
Designation: Associate Professor
Organisation / Institution Name: Malla Reddy Engineering College (MREC-A)

Address (Official): Room No. G7,
Environmental Engineering Lab, Civil Block
Malla Reddy Engineering College (MREC-A)
Maisammaguda-500100

Address (Residential): Plot No.539,
HMT Hills, Opp JNTUH
Kukatpally
Hyderabad-500072

Mail id: poodarisaritha@gmail.com

Date of Birth: 23-06-1976
Sex (M/F): F

7. Co-Investigator:

Name: **Dr.J.Selwyn Babu**
Designation: Professor
Department: Civil Engineering
Organisation / Institution Name: Malla Reddy Engineering College (MREC-A)

Address (Official): Room No. 301,
HOD Cabin, Civil Block
Malla Reddy Engineering College (MREC-A)
Maisammaguda-500100

Address (Residence): P304, Hivision Residency,
Kompally, Secunderabad – 500 014

E-mail: selwynbabu@gmail.com

Date of Birth: 24.07.1980
Sex (M/F): M

8. Capability of the Organization:

(a) Expertise available

Malla Reddy Engineering College (Autonomous) is one of the premier engineering colleges in Hyderabad, Telangana. MREC(A) is part of Malla Reddy Group of Institutions (MRGI), founded by Sri. Ch. Malla Reddy, currently Hon'ble Minister, Labour and Employment, Factories, Women and Chile Welfare and skill development, Govt. of Telangana State, who has invaluable insights into technical education of highest quality. The college is situated in a serener, lush green environment on Kompally-Bahadurpally Road, Opposite Forest academy, Mechal l- Malkajgiri District, Telangana State.

The college was established in 2002 and is an autonomous institution approved by UGC and affiliated to JNTUH. The college is re-accredited by NAAC with 'A' Grade (II Cycle) and was conferred autonomous status by JNTUHF in 2011 and by UGC in 2014 for a period of 6 years. Our eligible UG and PG programs received NBA accreditation and some of them received reaccreditation too.

The college caters to wide ranging aspirations and goals of student communities by offering relevant courses and programs in various streams of Engineering & Technology and Management. It boasts of world-class infrastructure and well equipped laboratories in all departments and received more than 50Lakhs amounts projects from various funding agency.

Sl. No	Name of the Lab	Major Equipment/Components	Purchase year	Cost
1.	Innovation Lab	3D Printing, PCB Fabrication, DSO, Cadence design software, FPGA kit, Various Sensors and High end systems	2018	15,00,000.00
2.	LabView Industry Sponsored Laboratory (National Instruments (NI) Bangalore)	My RIO, Core i5 or i7 processor @ 2.6GHz (64-bit), 8 GB, 1024 x 768 pixels, Dell OptiPlex 7010 Desktop PC - Intel Core i5-3470 3.2GHz 8GB 1TB H	2017	40,00,000.00
3.	Computer Lab with Amazon Web Service (AWS) – You can change as per your proposal	High configuration system with server	2017	23,00,000.00

(b) List of on-going and completed projects giving the following details

1. Details of Minor Research Projects funded by UGC

Sl. No.	Name of the Project	Department	Amount sanctioned Rs	Status	No. of Papers Published
1)	Hybrid Power transmission through Fluid coupling	Mechanical Engg.	2,60,000	**Completed**	2
2)	Load Flow contingency analysis, state estimation and optimal operation	EEE	1,80,500	**Completed**	2
3)	Image and gesture based single user transportation system	ECE	97,000	**Completed**	2
4)	Single phase bidirectional PWM converter for microgrid systems	EEE	2,60,000	**Completed**	2
5)	**Environmental impacts on soil and water quality with special reference to pharma industry using remote sensing and geographical investigation systems**	**Civil Engg.**	**2,40,000**	**Completed**	**1**
6)	**Degradation of some of the Usepa listed recalcutrants using nano size semi conductors**	**Civil Engg.**	**2,50,000**	**Ongoing**	**4**

7)	Synthesis characterization of Cu, Co and Au moxifloxacin nano metal complexes by eco-friendly methods and their biological applications	Chemistry	3,10,000	**Completed**	3
8)	Tunnable white light luminescence properties of rare earth ions doped $MnAl_2O_4$ Hybrid nano particles	Physics	1,50,000	Ongoing	1
9)	Green synthesis of gold nano particles used in Tumor targeted drug delivery system	Chemistry	2,59,000	Ongoing	1
TOTAL FUNDS Rs.			**20,06,900/-**		

2. Details of UBA (Unnat Bharat Abhiyan) funded by AICTE AQIS

Sl.No	Title of the Project	Department	Amount in Rs	Status
1)	Unnat Bharat Abhiyan	Institution	**50,000.00**	Completed

3. Details of Funds by AICTE AQIS

Sl.No	Title of the Scheme	Department	Amount in Rs	Status
1.	MODROBS – Software Defined Radio	EEE	12,71,000.00	In Process
2.	FDP- Big Data Analytics Using R, Hadoop and Spark	CSE	3,90,000.00	February 2020 (Completion date)
3.	STTP- LabView for Measurements and Data Analysis	EEE	2,73,000.00	Completed
4.	STTP- Research Methodology in Engineering and Technical writing using Latex	CSE	2,92,000.00	Completed
TOTAL in Rs.			**22,26,000.00**	

4. Details of ISTE Refresher Programme funded by AICTE

Sl.No	Title of the Project	Department	Amount in Rs	Status
1.	AICTE-ISTE Sponsored 6-Day Refresher Programme on "Engineering Drawing-An Effective Teaching Methodology	Mechanical	3,00,000.00	Completed

5. Details of Research Promotional Scheme (RPS) funded by AICTE

Sl.No	Title of the Project	Department	Amount in Rs	Status
1.	RPS- Power Electronics	EEE	15,00,000.00	Provisionally selected and Recommended

(a) Expertise available: (Department)

- Concrete Technology lab with Compression Testing machine, Efflorescence test (presence of soluble salts), water absorption test, brittle Test, moulds, Hardness Test
- Environmental engineering lab with water quality testing (leachate testing) both physic-chemical and microbiological analysis

(b) List of on-going and completed projects giving the following details:

(i) Project Title: Treatment of non-biodegradable pollutants commonly found in industrial wastewaters using advanced techniques
Start date: 05-05-2009
Completion date: 31-03- 2012
Project Cost : Rs.12.5 lakhs
Sponsoring Organisation: Department of Science & Technology (DST-WOS-A)

(ii) Project Title: Degradation of some of the USEPA listed recalcitrants using Nanosize semiconductors
Start date: January 2015
Completion date: Ongoing
Project Cost : Rs.2.5 lakhs
Sponsoring Organisation: University Grants Commission (UGC)

B. TECHNICAL DETAILS

1. Background

Description of problem:

Waste seems to be a by-product of growth with industrialization. Hazardous waste is the severely concerned issue which causes not only environment pollution, but also several ill health effects on human beings. The environmental technology, disposal and treatment of hazardous industrial waste have been a dormant issue that has recently been activated by the passage of the Resource Conservation and Recovery Act (RCRA). With increasing environmental degradation, high energy consumption, and financial limitations, various organizations in India and abroad, as well as United States Environmental Protection Agency (USEPA) have recommended various qualitative guidelines for generation, treatment, transport, handling, disposal, and recycling of non-hazardous and hazardous wastes. Already accumulated solid wastes and increasing annual production are a major source of pollution.

Review of work already done:

Selnur Ucaroglu, *et al* (2012), found that recovery of the waste for construction applications was possible when the waste content of the mortar was < 20%. **Milica Arsenovic *et al* (2012)** studied the removal of toxic metals from industrial sludge by fixing in brick structure. They tested the utilization possibilities of industrial sludge in masonry industry, as well as risk of toxic elements leaching potential. **Shane Donatello, *et al* (2012),** carried an assessment of Mercury immobilisation in alkali activated fly ash (AAFA) cements. To evaluate the potentiality of the AAFA cement matrix to immobilise Hg from an external source, another batch of cements. **S.P. Raut, *et al* (2011)** worked on various physico-mechanical and chemical properties of the bricks incorporating different waste materials were studied in accordance with the standards. **Eisa Hekal, *et al* (2010),** investigated the immobilization of Co (II) in various cement matrices by using the solidification/stabilization (S/S) technique. In this study they used different cement pastes, where ordinary Portland cement while in absence and presence of water reducing- and water repelling-admixtures as well as blended cement with kaolin.

Rationale for taking up the project:

In India, about 7.2 million tonnes of hazardous wastes is generated annually. For the industries, disposal of sludge is very costly method, due to long-distance transportation and the use of illegal or question able disposal methods. This needs to be alternative management method for global sustainability. In recent years, the utilization of solid waste has become a potential challenge for the researchers to recycle the valuable material and reduce the volume of hazardous solid waste and other pollutants, which is harmful for living organisms. In general, there are a number of options available for managing the hazardous wastes, and choice of methods depends upon the type of waste. Hence, it is now a global concern, to find a social, techno-economic, environmental friendly solution to sustain a cleaner and greener environment.

Relevance to State priorities:

- The State of Telangana moving toward its economic future, the amount of various types of solid waste, one of the most important by-products of urbanization & industrialization, is growing even faster than the rate we are anticipating. Generation of solid wastes is directly linked to economic development. As standards of living and incomes are increasing, production & consumption of goods and services increases, which results in a corresponding increase in the amount of waste generated. Telangana is the Fastest and one of the rapidly growing states of India. The economy of Telangana is shifting from agricultural-based to industrial & services-oriented. About 39% population in Telangana is now living in urban areas and is expected to grow rapidly. The rapid urbanization and industrialization is going to contribute more quantities and complex waste. Management of these solid wastes is very much essential to mitigate the adverse impacts on the environment and human health.

2. Challenge & Constraints

The second largest populated country in the world, India faces various hindrances to its development. Solid Waste Management is of critical concern and needs attention. Whereas many developed countries are searching for ready-made sustainable waste management solutions, India has created institutions to take on the big challenge of formal research on the topic. The current waste management practice in India involves collecting waste from sources through a community collective bin system, after which it gets transported to a low-lying landfill system with intermediate processing of Municipal Solid Waste (MSW). The open dumping practice is leading to various problems like pollution and health hazards. Both surface and groundwater are affected by this; in fact, groundwater is in a critical state. Current procedures are not ideal, hence, the solid waste management crisis. The major problems affecting solid waste management are unscientific treatment, improper collection of waste, and ethical problems. This in turn leads to hazards like environmental degradation, water pollution, soil pollution, and air pollution.

Strengths:

- 10 years of research experience in **'Environmental Research'** with special reference to the treatment of industrial effluents using advanced oxidation process and expertise on water, sediment and soil quality analysis along with their remediation using various physico-chemical methods.
- Already preliminary work is being done on this topic using pharmaceutical sludge.

Weakness:
Characterization studies of bricks like XRD, FTIR, and EDAX have to be done in other universities as there is no facility in the present college.

3. Description of Proposal

Objectives of the project

- Identification and characterization of hazardous wastes.
- Screening and utilization of solid waste for eco-economic products manufacturing.
- Stabilization of inorganic salt using Pozzolan/Portland cements
- Adoption of different waste material to improve the S/S product.

- Evaluation of physical engineering properties of S/S product application.

Preliminary Investigations done by organization

Preliminary studies were done on utilization of pharmaceutical sludge for manufacturing eco-friendly bricks. The immobilization of toxic metals in the pharmaceutical sludge was studied using the solidification/stabilization (S/S) technique. Different mixtures of cement and lime as binders and additives (pulverized fly ash and quarry dust) were used in the study to reduce the mobility of the metal content of the pharma sludge as well as to strengthen the brick. The strength of the brick was measured using Universal Testing Machine and the toxicity of the brick was done by toxicity characteristics leaching procedure (TCLP) Tests. The results showed that S/S technique had a strong fixing capacity for heavy metals and all the brick specimens prepared were observed to be sufficient in achieving the target compressive strength (5 N/mm^2) and was also found to be economically feasible when compared with a normal red brick.

S&T component in the project

The purpose of treating hazardous waste is to convert it into nonhazardous substances or to stabilize or encapsulate the waste so that it will not migrate and present a hazard when released into the environment. Stabilization or encapsulating techniques are particularly necessary for inorganic wastes such as those containing toxic heavy metals. According to the US Environment Protection Agency (USEPA), **Solidification or stabilization (S/S)** is the Best Demonstrated available Technology (BDAT) for 57 hazardous wastes.

Solidification/stabilization (S/S) is a process that involves the mixing of a waste with a binder to reduce the contaminant leachability by both physical and chemical means and to convert the hazardous waste into an environmentally acceptable waste form for land disposal or construction use. Several binder systems are currently available and widely used for S/S. Cement-based stabilization is best suited for inorganic wastes, especially those containing heavy metals. Due to the high pH of cement, the metals are retained as insoluble hydroxide or carbonate salts within the hardened structure. Portland cement is the most commonly used Stabilization/Solidification (S/S) reagent today. It is not only used alone, but also in several formulations combined with fly ash, lime, soluble silicates, clays and other materials. The mixture, upon addition of water, produces a hardened paste. This paste will bind together aggregates and other substances to form concrete and stabilized waste.

The unfired brick making process is the solidification/stabilization process of sludge with cement. This process relies on the formation of cementitious substances such as portlandite ($Ca(OH)_2$, P), calcium silicate hydrate ($CaO.SiO_2.nH_2O$, C–S–H), ettringite ($3CaO.Al_2O_3.3CaSO_4.32H_2O$, E) and monosulphate ($3CaO.Al_2O_3.CaSO_4.12H_2O$,m) in the matrix due to cement hydration, and thus the sludge chemically fixed in the lattice of these hydration products or physically encapsulated in the matrix.

$$2(3CaO \cdot SiO_2) + 6H_2O \longrightarrow 3CaO \cdot 2SiO_2 \cdot 3H_2O + 3Ca(OH)_2$$

$$2(2CaO \cdot SiO_2) + 4H_2O \longrightarrow 3CaO \cdot 2SiO_2 \cdot 3H_2O + Ca(OH)_2$$

Linkage with S&T Instts./NGOs/ resource persons / R&D organisation / Industry for technical back-up: Nil

Other organizations working in this area: JNTUH

Methodology detailing stepwise activities and sub-activities:

1. The present study is aimed to recycle/convert the residual wastes of various industries:
   - Identification of hazardous compounds in the industrial solid hazardous wastes.
   - S/S method adoption for industrial waste at different composition levels.
   - Prepared Specimen's reaction products identification using XRD, FTIR, EDAX, and TGDTA methods.
   - The physical properties of the S/S products will be evaluated in terms of Bulk density, Compressive strength, Water absorption and Porosity.
   - Best quality S/S composition will be adopted for pilot scale study.

2. Unfired bricks will be manufactured by using following material.

- Hazardous industrial sludge

Waste binders

- Portland cement
- Cement kiln dust
- Pulverized fuel ash
- Mixtures of fly-ash and cement
- Lime
- Lime kiln dust
- Mixtures of fly-ash and lime

Adsorbents

- Hydro and organophillic clays
- Wood chips, sawdust, rice hulls

Thermoplastic materials

- Asphalt bitumen
- Thermoplastic polymer

Additives to increase the S/S

- Silica fume
- Quarry dust
- Carbon black

3. Methodology

After collection of the material, they will be characterized (physic-chemical and trace metal) by following the standard methods. The ETP sludge will be dried in a hot air oven for 24 h at 105°C. After that it will be ground to less than 9.5mm in size to aid workability of the sludge-ash-binder mixture during casting. The PFA and BINDER will be mixed and blended with water. The dried sludge will be added to blended mixer. After fine mix, the industrial by-products silica fume and quarry dust will be added to develop the strength of the brick.

This mixture for unfired waste bricks will be fabricated in wooden moulds with internal of dimensions of 120 mm X 65 mm X 30 mm cubes to make the bricks. The bricks will be prepared as per the BIS standard (**IS: 40316, 1077-1992)** to achieve required compressive strength. The moulds filled with above prepared admixers will be kept in moist conditions for 24h. At the end of this period the bricks will be removed from the moulds and cured in air at room temperature for 28 days and will be checked for other engineering properties.

4. Work Plan

Activities	**3 months**			**6 months**			**3 months**		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
Procurement of material/equipment									
Identification of hazardous waste									
Characterization Studies of hazardous waste									
Optimization of experimental conditions for making of bricks									
Analysis of bricks for engineering properties									
Toxicity evaluation studies									
Data compilation & Publication of results	***1-2 International papers with high impact factor***								

5. Output of the Project

- The methodology developed using different additive compositions is useful for producing a '**Clean and Eco-friendly**' products.
- This study on successful completion can serve as an excellent management method with economical-suitability, where the industrial waste can be reused as by-product.
- The industrial waste exchange can become a rich source for stock holders at the final stage of this research work.

6. Likely Impact

- The work done both in India and abroad showed various environmental threats due to disposal of these wastes without minimizing/detoxifying the contaminants. Some of the wastes are indeed resources and raw materials and can be used in another industry.
- However, opportunities for this approach may be limited as a result of mismatches between waste stream composition and process specifications. These approaches can be justified because of savings in raw materials and energy inputs, as well as reductions in the costs of disposal.
- Presently, in India, about 28% of the total energy resources are accounted for the development of various building materials. With regard to saving energy, it is reported that for production of alumina requires about 200–250 MJ/kg of energy.
- Similarly the manufacturing of the stainless steel and copper requires 100MJ/kg each;

cement consumes 5–8MJ/kg, clay bricks and tiles require 2–7 MJ/kg of energy.

- Incorporating 25% of fly ash or 40% blast furnace slag in portland-pozzolana cement saves 30% energy and results in the product of equivalent quality to that of original portland cement.
- Further in making burnt clay bricks, addition of 25% fly ash with clay soil could save 15% energy

7. Parameters for monitoring effectiveness of project:

(i).Technical parameters

- Compressive strength
- Water Absorption test
- Porosity
- Reaction product identification by XRD in the brick matrix
- FT-IR analysis for reaction product in brick matrix
- Toxicity Leachate tests using EDAX

(ii). Internal Assessment of the project every month by the college R&D group

(iii). Presenting the work in conferences

(iv). Publication of results in peer reviewed journals

8. Suggested Post Project Activities:

- Can file a patent after successful completion of the project
- Can be scaled for a pilot study on real field

C. BUDGET ESTIMATES : SUMMARY

S.No	Item	Budget (Rs.)1st Year
1	Salaries/Wages	1,20,000-00
2	Consumables	1,50,000-00
3	Travel (within India)	50,000-00
4	Other costs	1,80,000-00
	Total	**5,00,000-00**

BUDGET FOR SALARIES / WAGES

S.No	Designation/No.of Persons	Budget (Rs.) 1st Year	
		Monthly emoluments	**Total (12 months)**
1	Full time (Project Assistant)	10,000-00	1,20,000-00
		Total	1,20,000-00

BUDGET FOR CONSUMABLES

S.No	Item	Budget (Rs.)1st Year
1	Chemical Admixtures	75,000-00
2	Coarse aggregate	15,000-00
3	Fine aggregate	15,000-00
4	Cement & Moulds	10,000-00
5	Mineral Admixtures	5,000-00
6	Weighing Balance	30,000-00
	Total	1,50,000-00

BUDGET FOR TRAVEL

S.No	Travel	Budget (Rs.)1st Year
1	Local (For collection of samples & Analysis of samples)	30,000-00
2	Out station (Attending Seminars/Conferences)	20,000-00
	Total	50,000-00

BUDGET FOR OTHER COSTS

S.No	Item	Budget (Rs.)1st Year
1	Contingencies	50,000-00
2	Hiring Services	30,000-00
3	Analytical Charges (XRD, FTIR, EDAX)	1,00,000-00
	Total	1,80,000-00

D. PROFORMA FOR BIO-DATA OF INVESTIGATORS (PI & CO PI)

A. Name : **Dr.P.SARITHA**
B. Date of Birth : 23-06-1976
C. Institutions: MALLA REDDY ENGINEERING COLLEGE (A)
D. Whether belongs to SC/ST: NO
E. Academic career: Ph.D, CSIR-RA
Professional career: Research experience: 10 yrs
Teaching experience: 6years
F. Award/prize/certificate etc won by the investigator:

- DST - **Women Scientist**
- Presented paper in International conference on Environment and Energy and has been awarded for the **'Best paper presentation'.**
- **Chaired a Technical Session in** International conference on Environment and Energy

G. Publication (Numbers only):

Books-0 Research Paper-**20** General articles-0
Patents-**1** Others (please specify)

Projects completed

S.No	Title of the project	Duration From To	Total Cost (Rs)	Funding Agency
1	Treatment of non-biodegradable pollutants commonly found in industrial wastewaters using advanced techniques	2009-2012	12,50,000-00	DST

Projects ongoing

S.No	Title of the project	Duration From To	Total Cost (Rs)	Funding Agency
1	Degradation of some of the USEPA listed recalcitrants using Nanosize semiconductors	Jan 2015-till date	2,50,00-00	UGC

PROFORMA FOR BIO-DATA OF INVESTIGATORS (CO PI)

A. Name : Dr. J. Selwyn Babu
B. Date of Birth : 24.07.1980
C. Institutions: Malla Reddy Engineering College, Maisammaguda, Secunderabad
D. Whether belongs to SC/ST: No
E. Academic career: Ph.D.
Professional career: Professor with 13 years experience
F. Award/prize/certificate etc won by the investigator:
G. Publication (Numbers only):

Books	Research Paper: 20	General articles
Patents: 1	Others (please specify)	

Sl.No.	Title of Project	Duration		Total cost	Funding Agency
		From	To		

I. Projects submitted

Sl.No.	Title of project	Name of Organisation	Status

(Name & Signature)

Date
Place

E. ENDORSEMENT FROM THE HEAD OF INSTITUTION
(TO BE GIVEN ON LETTER HEAD)

9. PROJECT TITLE: **CONVERSION OF SOLID HAZARDOUS WASTE TO ECO-ECONOMIC PRODUCTS**

1. Certified that the Institute welcomes participation of **Dr.P.Saritha** as the Principal Investigator and **Dr.J.Selwyn Babu** as the Co-Investigator for the project and that in the unforeseen event of discontinuance by the Principal Investigator, the Co-Investigator will assume the responsibility of the fruitful completion of the project (with due intimation to DST (GOI)

2. Certified that the equipment, other basic facilities and such other administrative facilities as per terms and conditions of the grant, will be extended to investigator(s) throughout the duration of the project.

3. Institute assumes to undertake the financial and other management responsibilities of the project

Name and Signature of Head of Institution

Date:
Place