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Cost Reduction in Consumables, Used for Metallurgical Sample Preparation

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Abstract: *Chennai Mettex Lab is a leading testing laboratory, providing testing solutions to its numerous clients for over two decades. Their mission is to respond to industry needs for analytical services with diversified interests dedicated to the services with environmental consciousness. They perform tests on both ferrous and non-ferrous metals, and alloy samples. The aim of this project is to reduce the cost in consumables used for metallurgical sample preparation. We are analyzing the usage of consumables to identify the expenses which are unnecessary. And from the study we are suggesting the ideas to overcome the unwanted cost. Ultimately from all of the analysis and result it was determined that, the useful cost reduction suggestions to the company.*

INTRODUCTION

Chennai Mettex LAB is a leading testing laboratory, providing testing solutions to its numerous clients for over two decades. Established in 1984, Under the leadership of Mr. V. K. Selva Kumar for more than 2 decades, has become a trusted testing laboratory for innumerable clients. The Company has been promoted by some highly experienced Professionals dedicated to provide total testing solutions under one roof. It possesses not only the latest technology gadgets but also the most knowledgeable and experienced hands to offer most customized solutions. They provide a complete range of services which allows you to use Chennai Mettex LAB as a single source for all your testing needs. They are a very well established company located in Guindy, Chennai, with a state-of-the-art development center, which is constantly developed & updated with the latest Technology also provides high quality on site services.

Their Vision: To continuously strive to achieve highest standards of quality analytical services in the concurrence with client's expectations on a professionally cost effective manner.

Their Mission: Their mission to respond to industry needs for analytical services with diversified interests dedicated to the services with environmental consciousness. They test certificates are reliable as these are based on accuracy and impartiality.

Their Staffs: Chennai Mettex LAB is equipped with state - of - art instrumentation to provide the most advanced and reliable testing services. A company dedicated to producing quality work & exemplary customers services backed by years of real world experience, expertise & infrastructure. They do posses a strong team of experienced Metallurgists and chemists with expertise in the areas of Chemical Testing, Mechanical Testing, Non - Destructive Testing, Metallographic, Welders Qualification procedures, Corrosion Testing, Failure Analysis and Testing of Rubber, Plastics, Paints and Grease. For a full understanding of our services, we encourage you to visit our laboratory. Their technical staff will be glad to give you a personal tour and discuss your testing requirements. Experience for yourself how are services can give you the winning edge in this highly competitive and fast-changing global market.

Quality Of Their Policy: They shall deliver testing &services to meet our customer requirements on time using creativity, flexibility, production depth and technical expertise in performing simple or complex analyses, with total focus on customer satisfaction and quality workmanship.

THEIR TECHNICAL COMPETENCY

They are committed to provide precise analytical results by engaging advance testing machinery and equipments. A well-experienced and qualified technical manpower ensures perfect testing confirming to the international standards and norms. Our research and development capabilities facilitate us to bring novel and innovative methodologies to meet new industrial challenges and clients' needs and specifications.

Their equipments

Major instruments list – chemical

INSTRUMENTS / EQUIPMENTS	MODEL / TYPE /S.NO & YEAR	NAME OF TEST FOR WHICH USED
pH Meter - 01	EU TECH - TUTOR	**Measure pH**
Conductivity Meter	Deep Vision/601E	**Measure EC**
Turbidity Meter	Elico – CL 52 D	**Measure Turbidity**
UV-Vis Spectrometer	UV 1601PC/ Shimadzu	**Nitrate, Nitrite, Iron Etc.,**
Atomic Absorption Spectrometer	AA240 / Varian, Australia	**Heavy Metals like Cu, Cd, Hg etc.,**
Flame photometer	Elico	**Na, K**
ICP - OES	Varian, Australia	**Australia**
GC MS MS	Termofisher, USA	**USA**
LC MS MS	Waters, USA	**USA**
Hot Air Oven – 02	Hasthas 03072164	---
BOD Incubator – Water	Hasthas 2006 – PT - 100	**BOD Analysis**
Salt spray Chamber Temperature Pressure	Servo- Oct 2004 Temp controller with sensor Autonics / TZ4STWaree / USG	
Carbon Sulfur Apparatus	Hasthas 0606271	
Electro gravimetric Analog DC Ammeter	BEEMET – DCF – 65	

Major Instruments List– Metals

INSTRUMENTS / EQUIPMENTS	MODEL / TYPE /S.NO & YEAR	NAME OF TEST FOR WHICH USED
Universal Testing Machine - 400KN- 2002	FIE / UTE 40	TENSILE & YIELD
Tensile Testing Machine - 2500 Kg	1.3DKMI	TENSILE & Elongation
Microscope	Metzer	Micro structure
Hardness tester - Rockwell	PSI	Rockwell Hardness
Hardness Tester-Shore 'A'	Blue Steel SHR-A- Gold	Rubber Hardness
Dial thickness gauge	AOIS,1097	Rubber thickness
Impact Tester	Varsha / IT 30STD	Impact
Vickers & Brnell Hardness tester	VEB - HP0250	Vickers Hardness
Micro Vickers hardness tester	EVERONE MH6	Micro Vickers Hardness
Optical Emission Spectrometer	Shimadzu/PDA7000	Chemical Composition
XRF Spectrometer (PMI Metal Sorter)	Bruker, Germany	Chemical Composition

MAJOR INSTRUMENTS LIST– AIR

INSTRUMENTS / EQUIPMENTS	MODEL / TYPE /S.NO & YEAR	NAME OF TEST FOR WHICH USED
High volume air sampler RDS – 1, RDS - 2	RDS 9000	
Sound level meter	LUTRON/ SL 4001	Measure Sound
Stack Kit and accessories	SEA 90	
Inclined Manometer	AERO VIROMENT /**SEA 90 / 061203**	
Rotameter -	Process Sensors - 578	
S – Type Probe	061203	
Orsat Apparatus		
Digital temperature indicator with sensor - AIR	CE - 305	
Meteorological senser	Tech Mark	
Vacuum gauge - NOx	KI – 4 - 059194	
CO Analyser		

TABLE - 3

MAJOR INSTRUMENTS LIST– MICROBIOLOGY

INSTRUMENTS / EQUIPMENTS	MODEL	NAME OF TEST FOR WHICH USED
pH Meter	Sansel / pH 300	Medias pH
Autoclave	Hasthas	Sterilization of Medias
Water Bath – Digital temp controller with sensor	Selectron DTC 504, 0701-J12-607	Culture & Sample Incubation
BOD Incubator – Micro	Hasthas	Culture & Sample Incubation
Laminar Air flow	Hasthas	Culture & Sample Inoculation
Hot Air Oven - 01 with temp controller and sensor	Hasthas 03072162	
Microscope	Magnus MLX	Microbes Observation
Biological Incubator 1, Biological Incubator 2, Biological Incubator 3	Hasthas / PT 100	Culture & Sample Incubation
Colony Counter	Labtronics	Count the Colonies
Deep Freezer - Digital temp controller with sensor	Thermotech TH - 013	Cultures & reagents storage
Cyclo mixer	REMI (CM101)	

AREA OF PROJECT

Metallography is the study of a materials microstructure. Analysis of a materials microstructure aids in determining if the material has been processed correctly and is therefore a critical step for determining product reliability and for determining why a material failed. The basic steps for proper metallographic specimen preparation include: documentation, sectioning and cutting, mounting, planar grinding, rough polishing, final polishing, etching, microscopic analysis, and hardness testing.

Documentation: Metallographic analysis is a valuable tool. By properly documenting the initial specimen condition and the proceeding microstructural analysis, metallography provides a powerful quality control as well as an invaluable investigative tool.

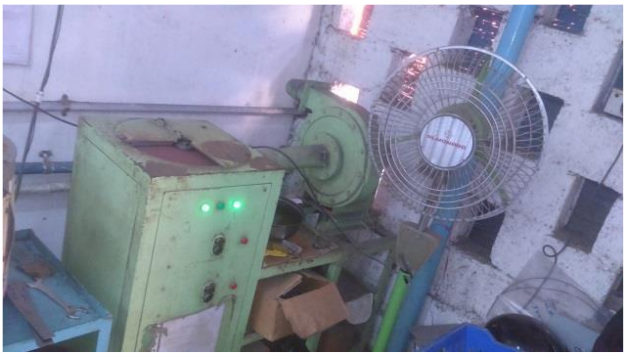
Sectioning and Cutting: Following proper documentation, most metallographic samples need to be sectioned to the area of interest and for easier handling. Depending upon the material, the sectioning operation can be obtained by abrasive cutting (metals and metal matrix composites), diamond wafer cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics). Proper sectioning is required to minimize damage, which may alter the microstructure and produce false metallographic characterization. Proper cutting requires the correct selection of abrasive type, bonding, and size; as well as proper cutting speed, load and coolant. Table I list the most common type of abrasive blades used for metallographic sectioning and Table II lists cutting parameters for diamond wafer cutting.

Mounting: The mounting operation accomplishes three important functions it protects the specimen edge and maintains the integrity of materials surface features fills voids in porous materials and improves handling of irregular shaped samples, especially for automated specimen preparation. The majority of metallographic specimen mounting is done by encapsulating the specimen into a compression mounting compound (thermosets - phenolics, epoxies, diallyl phthalates or thermoplastics - acrylics), casting into ambient castable mounting resins (acrylic resins, epoxy resins, and polyester resins), and gluing with a thermoplastic glues.

Compression mounting: For metals, compression mounting is widely used. Phenolics are popular because they are low cost, whereas the diallyl phthalates and epoxy resins find applications where edge retention and harder mounts are required. The acrylic compression mounting compounds are used because they have excellent clarity. Table IIIa and IIIb list the application as well as the physical properties of the most common compression mounting resins.

Castable mounting resins: Is commonly used for electronic and ceramic materials. Castable mounting resins are recommended for brittle and porous materials. These mounting compounds are typically two component systems (1-resin and 1-hardener). Typical curing times range from minutes to hours with the faster curing resins producing higher exothermic temperature which causes the mounting material to shrink away from the edge during curing. For example, the Acrylic Cold Mounting Resins cure in less than 10 minutes and Epoxy Castable Resins cure in approximately 4-6 hours. Note that adding an external energy source such as heat or microwave energy can enhance the Epoxy Castable Resin curing cycle. It is recommended that the room temperature be less than 85° F to avoid overheating and uncontrollable curing of the mounting compound. Table IV lists the basic properties of castable mounting resins.

Planar Grinding: course grinding is required to planarize the specimen and to reduce the damage created by sectioning. The planar grinding step is accomplished by decreasing the abrasive grit/ particle size sequentially to obtain surface finishes that are ready for polishing. Care must be taken to avoid being too abrasive in this step, and actually creating greater specimen damage than produced during cutting (this is especially true for very brittle materials such as silicon).



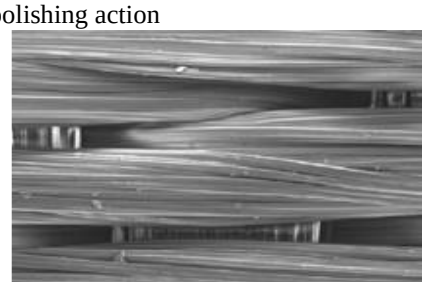
Grinding Pressure: Grinding/polishing pressure is dependent upon the applied force (pounds or Newton's) and the area of the specimen and mounting material. Pressure is defined as the Force/Area (psi, N/m2 or Pa). For specimens significantly harder than the mounting compound, pressure is better defined as the force divided by the specimen surface area. Thus, for larger hard specimens higher grinding/polishing pressures increase stock removal rates, however higher pressure also increases the amount of surface and subsurface damage. Note that for SiC grinding papers, as the abrasive grains dull and cut rates decrease, increasing grinding pressures can extend the life of the SiC paper. Higher grinding/polishing pressures can also generate additional frictional heat, which may actually be beneficial for the chemical mechanical polishing (CMP) of ceramics, minerals and composites. Likewise for extremely friable specimens such as nodular cast iron, higher pressures and lower relative velocity distributions can aid in retaining inclusions and secondary phases.

Relative Velocity: Current grinding/polishing machines are designed with the specimens mounted in a disk holder and machined on a disk platen surface. This disk on disk rotation allows for a variable velocity distribution depending upon the head speed relative to the base speed.

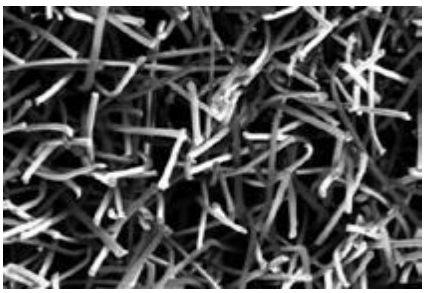
POLISHING CLOTH SELECTION GUIDELINE

Metal Mesh cloth: This is a wire mesh material useful for coarse and intermediate lapping/polishing. The texture of this wire allows for the abrasive to become semi-fixed; thus offering the advantage of increased stock removal, while minimizing damage.

Nylon Polishing Cloths: Are high napped final polishing pad for most metals and polymers. Its high nap provides it a very soft and gentle polishing action

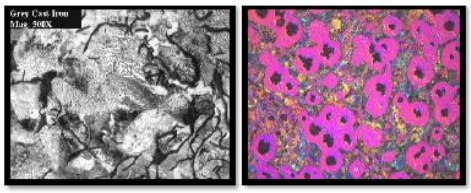


High Napped Polishing Pads: Are the most common final polishing cloths for metals and polymers. Its high nap provides it a very soft and gentle polishing action

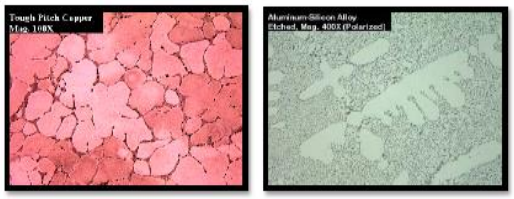


Metallographic Analysis: Metallurgical analysis (metallography) of the microstructural provides the Material Scientist or Metallurgist information varying from phase structure, grain size, solidification structure, casting voids, etc. Figure 2 shows an example of two cast iron structures. Figure 2a shows a cast iron microstructure which has graphite flakes. Over time this materials will most likely fail under load. On the other hand by adding some solidifying agents the cast iron can be made to form the more durable graphite nodules (Figure 2b). Figure 3 shows the grain size of a tough pitch copper. Analysis of a materials grain size provides valuable information regarding a materials physical hardness and ductility. Microstructural analysis can also provide very useful information about the types of phases that occur during cooling. Figure 4 shows the dendritic growth of the microstructure for an aluminum-silicon alloy which formed during solidification. The direction and size of these dendrites again relate to the materials strength and durability. Other examples of metallographic analysis include: analyzing printed circuit board (PCB) solder hole connections, microelectronic failure analysis, steel heat treating such as surface hardening, ceramic grain size and porosity, polymer composite fiber wetting and orientation, etc.

Cast Iron microstructures:



(a) graphite flakes (b) nodules



(C) Tough Pitch Copper (D) Aluminum-silicon alloy

COST ESTIMATION

A cost estimate is the approximation of the cost of a program, project, or operation. The cost estimate is the product of the cost estimating process. The cost estimate has a single total value and may have identifiable component values. A problem with a cost overrun can be avoided with a credible, reliable, and accurate cost estimate. An estimator is the professional who prepares cost estimates. There are different types of estimators, whose title may be preceded by a modifier, such as building estimator, or electrical estimator, or chief estimator. Other professional titles may also prepare estimates or contribute to estimates, such as quantity surveyors, cost engineers, etc. These correspond to modern published classes 5, 3, and 1, respectively. The U.S. Department of Energy and many others use a system of five classes of estimates:

Estimate class	Name	Purpose	Project definition level
Class 5	Order of magnitude	Screening or feasibility	0% to 2%
Class 4	Intermediate	Concept study or feasibility	1% to 15%
Class 3	Preliminary	Budget, authorization, or control	10% to 40%
Class 2	Substantive	Control or bid/tender	30% to 70%
Class 1	Definitive	Check estimate or bid/tender	50% to 100%

Cost Reduction: “Cost Reduction is to be understood as the achievement of real and permanent reduction in the unit cost of goods manufacture or services rendered without impairing their suitability for the use intended”. Cost Reduction is a systematic effort to improve profit margins by eliminating all forms of waste and unnecessary expense without impairing the generation of revenues. Some commonly used synonyms for this activity are profit improvement, cost improvement, and methods improvement. But, regardless of the terminology used, the aim of cost reduction is to offset the impact of a squeeze on profits by getting the maximum return for every rupee of funds spent by the company.

COST CONTROL TECHNIQUES

Budgetary Control: Budgetary Control is an establishment of budgets relating the responsibilities of a policy and the continuous comparison of actual with budgeted results either to secure by individual action the objective of that policy, or to provide a basis for its revision.

Bench Marking: It is measuring the company's performance against that of Best-In-Class companies determining how the Best-In-Class achieve those performance levels and using the information as a basis for the company's targets, strategies and implementation. Benchmarking is the process of comparing one's business processes and performance metrics to industry bests and/or best practices from other industries. Dimensions typically measured are quality, time and cost. In the process of benchmarking, management identifies the best firms in their industry, or in another industry where similar processes exist, and compare the results and processes of those studied (the "targets") to one's own results and processes. In this way, they learn how well the targets perform and, more importantly, the business processes that explain why these firms are successful.

Target Costing: Target costing refers to the design of product, and the processes used to produce it, so that ultimately the product can be manufactured at a cost that will enable the firm to make profit when the product is sold at an estimated market-driven price.

Cost Estimation in sample Preparation: Consumables used for sample Preparation, Bakelite Powder, Emery Sheets, Molding Relief spray, Diamond Paste, Abrasive wheels, Coolant, Tissue Paper, Cold Setting Powder, Cold Setting Liquid.

Estimated cost for sample Preparation

They bought the consumables about 3 months once. The bills are given below.

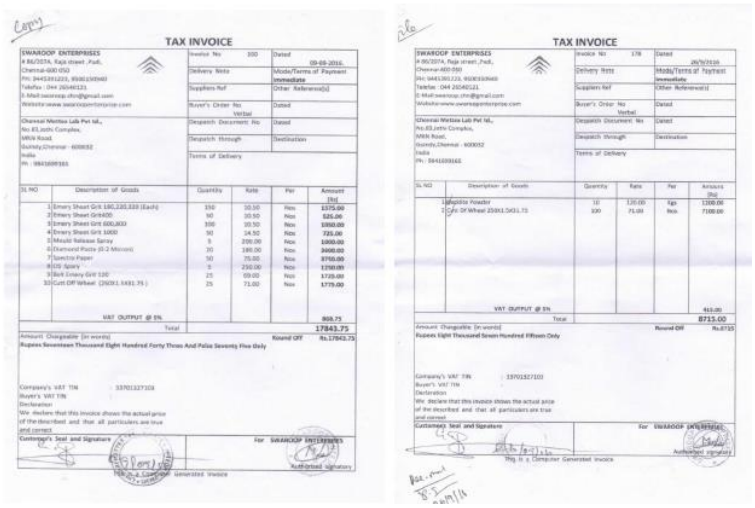


FIGURE 1. These bills are from the 9th month of 2016

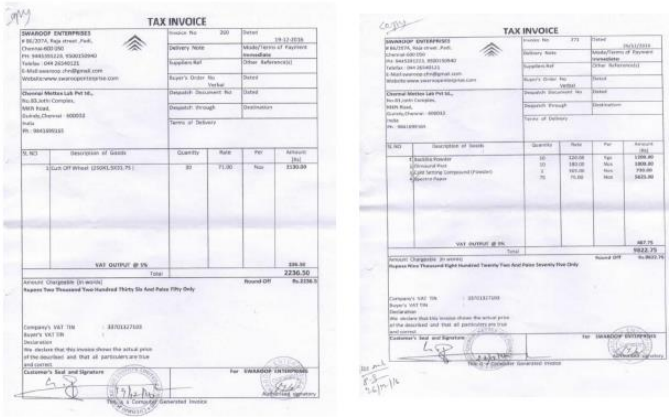
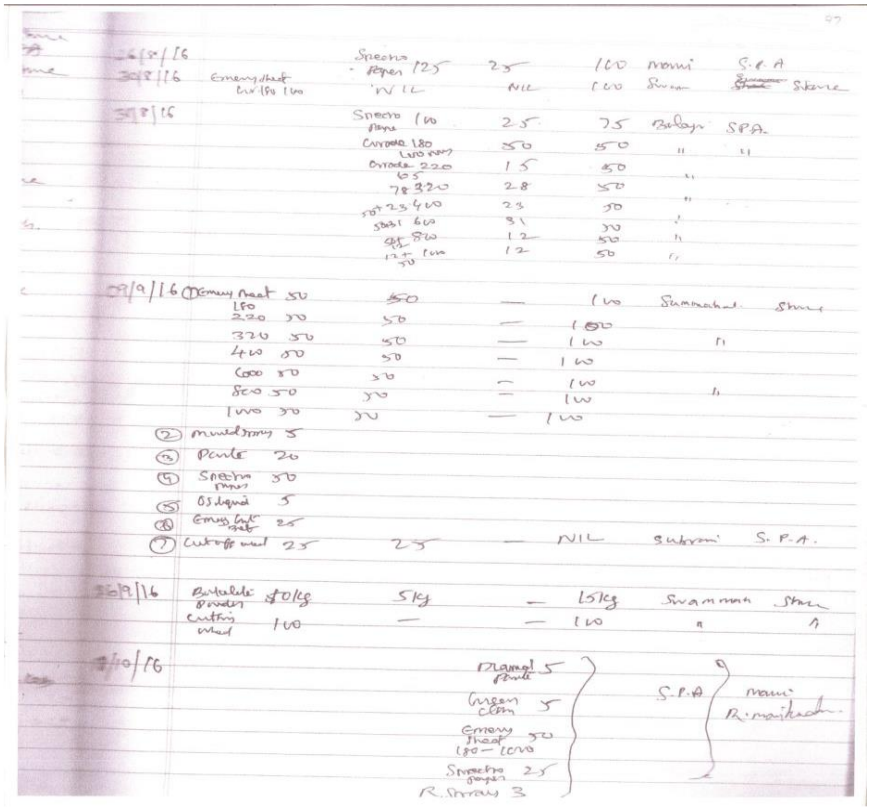


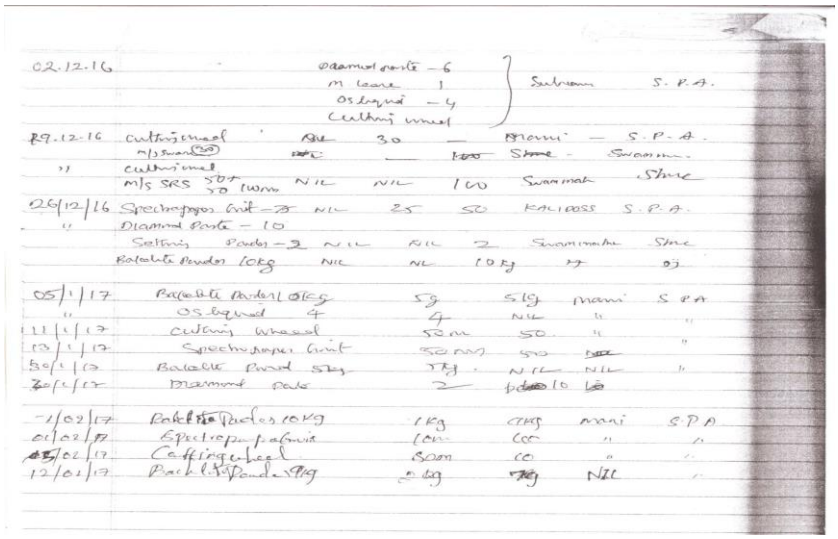
FIGURE 2. These bills are from the 12th month of 2016.

CONCLUSION

Our cost analyzing duration is about February 1 to February 11, during this period our suggestions were executed in the sample preparation area. From that suggestion the usage of consumables are reduced comparing before executing the suggestions. Over to the analyzing of consumables usage:



It is a consumable usage record from the 8th month of 2016 to 10th month of 2016.



It is a consumable usage record from the 12th month of 2016 to 2nd month of 2017. From these consumable records we can analyze the usage of difference between before and after suggestions.

Bakelite Powder: Before Suggestions the Bakelite Powder usage is 5 kg for 25 days and 2.5 kg for 10 days it is analyzed from the consumable usage record.
After Suggestions the Bakelite Powder usage is reduce upto 1kg for 10 days. Thus we are reduce 1.5 kg for 10 days. The cost of Bakelite Powder is Rs.60/- per kg. By this per month we can reduce Rs.270/- and for year we can reduce Rs.3240/-

Cut of Wheel: Before Suggestions the Cut of Wheel usage is 50 Wheels for 10 days it is analyzed from the consumable usage record. After Suggestions the Cut of Wheel usage is reduce up to 35 wheels for 10 days. Thus we are reducing 15 wheels for 10 days. The cost of the Cut of Wheel is Rs.71/- per wheel. By this per month we can reduce Rs.3195/- and for year we can reduce Rs.38340/-

The Consumable cost before Suggestions:

S.No.	Particulars	Qty	Rate	Amount for 10 days	Amount per month	Amount per year
1.	Bakelite Powder	2.5 kg	60.00	150.00	450.00	5400.00
2.	Emery Sheets	50	10.50	525.00	1575.00	18900.00
3.	Cut of Wheel	50	71.00	3550.00	10650.00	127800.00
	Total Amount			**4225.00**	**12675.00**	**152100.00**

The Consumable cost after Suggestions:

S.No.	Particulars	Qty	Rate	Amount for 10 days	Amount per month	Amount per year
1.	Bakelite Powder	1 kg	60.00	60.00	180.00	2160.00
2.	Emery Sheets	30	10.50	315.00	945.00	11340.00
3.	Cut of Wheel	35	71.00	2485.00	7455.00	89460.00
	Total Amount			**2860.00**	**8580.00**	**102960.00**

From this analysis our project reduce the notable amount for the company per year. The reduced amount per month is Rs.4095/- and per year Rs.49140/- Competitive sourcing appears to generate personnel cost savings: In this study, the expected annual personnel cost savings ranged between 35 percent and 40.95 percent of baseline costs. The personnel cost savings we observed were achieved primarily by using fewer people and downgrading positions. Contrary to expectations, substituting capital for labor or lower wage and benefit costs did not appear to be important sources of personnel cost savings in the competitions we examined. To accomplish work with fewer people, both contractors and government managers employed a wide variety of techniques -multiskilling, organizational restructuring, civilianization, increasing labor availability, increasing labor intensity, and reducing the scope of work.

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