

## REFURBISHMENT OF SPENT PALLADIUM IMPREGNATED CARBON (Pd/C)

The present technology pertains to the development of a cost effective and scalable process for Palladium (Pd) metal recovery from spent palladium impregnated carbon (Pd/C) cartridges used by Indian Navy for the oxidative removal of carbon monoxide. The Pd/C cartridges contain Pd which makes it expensive. In an endeavor to explore alternate strategies, studies were undertaken in laboratory to identify simple, cost effective and a scalable technique that can be easily adopted by industries for Pd recovery and reuse of the recovered metal for various applications. The extraction of palladium from Pd impregnated activated carbon has been conducted using different extraction routes at a laboratory scale. This has led to the efficient extraction of Pd from spent Pd/C with ~96% recovery. This would directly impact the cost of the cartridges as Pd can be recovered and reused. This technology is anticipated to have dual benefits. Firstly, recovery and reuse of spent Pd/C filter cartridges will lead to a savings of a minimum of 40% compared to procurement of fresh Pd/C filters. Secondly, waste management of the expended/ used filters containing metals, including precious metals such as Palladium will be efficient. The carbon support after metal removal is environmentally benign and easy to dispose. The refurbishment process of the used filter materials broadly involves three steps:

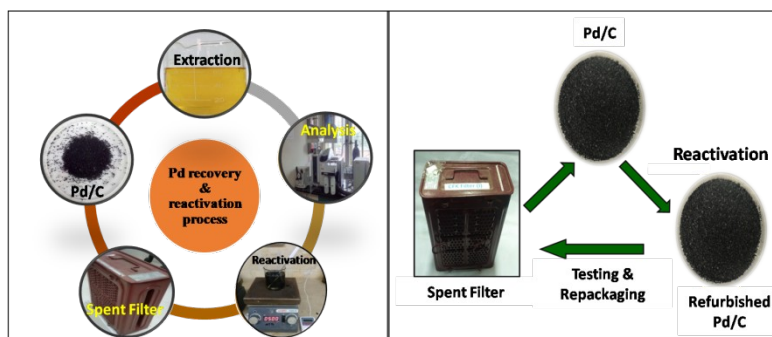
- i) Recovery/ Extraction of Palladium (Pd) from used filter cartridges
- ii) Functionalization of fresh Granular Activated Carbon (GAC)
- iii) Impregnation of extracted Pd onto fresh GAC
- iv) Reduction of impregnated Pd salt using suitable reducing agent

The raw materials include used Palladium Impregnated Granular Activated Carbon obtained from naval services, fresh Granular Activated Carbon (GAC). Other chemicals like mineral acids such as nitric acid, hydrochloric acid, alkali such as sodium hydroxide and suitable reducing agent like formaldehyde can be sourced from chemical suppliers.

The industry partner/ ToT holders having existing ToT for the Air Cleaning Filters with the infrastructure such as mixers, dryers, suitable lab wares, and reactors for scale-up and bulk production are ideally suited for the ToT of refurbishment of Pd/C filters. However, new industry partners with experience in manufacturing metal impregnated granular activated carbon (GAC) such as Pd, Pt etc and having the above infrastructure for scale-up can also take the ToT. Refurbished filter should qualify as per laid down accepted test procedures (ATP).

### Salient features:

- Palladium impregnated activated carbon developed from used Pd/C filters
- Technology reuses already impregnated Palladium metal
- Extraction method using various acid-based routes may be employed and subsequent re-impregnation on fresh activated carbon



**Figure: Schematic of the overall process**

1. Interested Companies/industries are requested to apply against this EoI to the following address:-

**To,  
The Director,  
Defence Bio-Engineering & Electro Medical Laboratory  
CV Raman Nagar, Bangalore-560 093  
Email- director.debel@gov.in  
Phone:080-22502314  
Fax No. 080-25282011**

2. A copy of interest may be sent to the following address without any attachment:-

**To,  
The Director,  
Directorate of Industry Interface & Technology Management (DIITM)  
Room No. 447, DRDO Bhawan Rajaji Marg, New Delhi-110 011  
Phone: 011-23013209/ 23015291  
Fax: 011-23793008  
Email: diitm[dot]hqr[at]gov[dot]in**

All industries interested in seeking ToT are requested to apply in the format given below. Kindly fill in the fields. The list of documents to be attached is provided in Annexure - I. Kindly provide the reference of page no. of supporting document in the relevant field of form.

### **PART-1**

#### **General Information**

(Please enclose documents in support of information provided)

1.	<b>Name of the Technology requested for Technology Transfer (Technology name and concerned Lab, Category)</b>	
2.	<b>Name of the industry/ organization</b>	
3.	<b>Complete Address and other details</b>	
	<b>Registered Office</b>  State Phone No Fax Email Website	
	<b>Factory</b>  State Phone No Fax Email Website	
4.	<b>Point of Contact</b> Name Designation Address Mobile No Ph No Email ID	
5.	<b>NAME OF CMD/ MD /PARTNERS/ PROPRIETOR/ etc</b> Name Designation Address Mobile No Ph No Email ID	
6.	<b>Date of Incorporation of company</b>	
7.	<b>Foreign Direct Investment in company (if any in %)</b>	
8.	<b>Shareholding pattern</b>	
9.	<b>Turn over as per Audited Balance Sheet for the preceding three years.</b> Year ____	

	Year ____ Year ____	
10.	<b>Annual budget for R&amp;D during last three years (if any)</b> Year ____ Year ____ Year ____	
11.	<b>Income Tax returns for the preceding three years period</b> <b>Year</b> ____ <b>Year</b> ____ <b>Year</b> ____	
12.	<b>Nature of company</b> DPSU, Private Limited, Public Limited, Partnership, Proprietary, Ex- Serviceman Unit	
13.	<b>Category of industry</b> Large Scale, Medium Scale, Small Scale, Micro, Startup	
14.	<b>MSME Registration No</b>	
15.	<b>Certificates of registration as a manufacturing unit, if any.</b>	
16.	<b>If Startup, DPIIT Registration No</b>	
17.	<b>UDYOG AADHAR No</b>	
18.	<b>PAN Number</b>	
19.	<b>Details of Industrial license for defence manufacturing issued by DPIIT (if any)</b>	
20.	<b>Details of PESO license (if any)</b>	
21.	<b>GST Number</b>	
22.	<b>Nature of business</b> Manufacturing/ Sole Selling or Authorized Agent/ Assembler/ Traders/ Dealer/ Processor/ Repacker/ Others	
23.	<b>Details of current products and services</b> Products and services Supplied (please specify Govt/ Domestic market/ Export)	
24.	<b>Record of past performance</b> (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).	
25.	<b>Details of registration</b> with NSIC / SSI, DGS&D, other Defence Department, other Govt. Dept, membership of FICCI/ASSOCHAM/CII or other Industrial Association <b>(Attach relevant copies of registration</b>	

	<b>letters)</b>	
26.	<b>Have you already taken any technology from DRDO</b> (If yes, give details attaching separate sheet)  Name of the Technology, Lab, Year, License number & Status	
27.	<b>ISO/ ISI certification or any other certification</b> (If yes, give details)	
28.	<b>Relevant clearances form the authorities/ ministries</b> (if any)	
29.	<b>Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.</b>	
30.	<b>Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.</b>	

## **PART-2**

### **Infrastructure and other Information**

<b>1.</b>	<b>Total area of factory</b> Covered (m <sup>2</sup> ), Uncovered (m <sup>2</sup> ), Bonded space available (m <sup>2</sup> )	
<b>2.</b>	<b>Ownership of factory</b> Self-owned, partnership, rental	
<b>3.</b>	<b>Electric power</b> Sanctioned Installed Standby (if any)	
<b>4.</b>	<b>Availability of adequate infrastructure</b> (List of machines and their production capacities) and technical expertise	
<b>5.</b>	<b>Name of bank &amp; A/c No Name of bank</b> A/c type A/c no Address of the bank Phone: Email:	

### **6. Details of current products:**

S.No	Type	Description	Licensed/installed capacity	Annual production for preceding 3 years

### **7. Details of foreign collaboration, if any**

S.No	Product	Name and address of collaborator	Year	Remarks


**8. Details of products developed for services**

S.No	Nomenclature of stores	Order No. and date	Remarks

**9. Please give details of important facilities & infrastructure as per following format for:**

- (a) Production
- (b) Unconventional, special m/c
- (c) Testing & quality control facilities

S.No	Description of m/c	Make & model	Qty	Date of purchase	Remarks

**10. Furnish the following details with relevant certificates and documents**

- (a) R&D facilities available :
- (b) Inspection quality control of raw material components :
- (c) Assistance from central agency for testing / calibration etc. :
- (d) laboratory and drawing office facility :

**11. Principal customers:**

S. No	Name & address	S.O No and date	Date of last supply	Products supplied	Value

**12. Future plans (if any) in respect of expansion programme/ installation of additional machines/ test facilities etc.**

**13. Name of the technology requested for transfer**

(give self-assessment of your capability to absorb the technology)

**14. Details of employee as on date on firm's pay roll**

<b>PERMANENT</b>				
Category	Post Held	Number	Qualification	Total Service
Technical	Prod. Manager			
	Q.C. Manager			
	Supervisor			
	Testing Staff (QC)			
	Skilled workers			
	Unskilled workers, etc			
Administrative	Purchase Manager			
	Accounts Officer			
	Office			

	Superintendent Clerical Others, etc			
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**TEMPORARY**

Category	Post Held	Number	Qualification	Total Service
Technical	Prod. Manager Q.C. Manager Supervisor Testing Staff (QC) Skilled workers Unskilled workers, etc			
Administrative	Purchase Manager Accounts Officer Office Superintendent Clerical Others, etc			

**DECLARATION:**

I / we confirm that the information furnished in Part 1 & 2 above is correct. In the event of any information given by me / us is found incorrect / false at any time, I / we understand our EoI for ToT will be cancelled/ rejected without notice, beside any other appropriate action against me / us.

Industry seal

Authorized signatory

Name(s) in capital

Designation and seal of authorized signatory

Date:

Place:

**List of Support documents to be attached with EoI**

- (a) Memorandum and Articles of Association (Should be incorporated as per Indian Companies Act, as amended time to time)
- (b) Certificates of registration as a manufacturing unit, if any.
- (c) Audited Balance Sheet for the preceding three years.
- (d) Income Tax returns for the preceding three year period
- (e) Details of shareholding/ownership pattern especially foreign partners/ shareholders, foreign employees, directors, etc. The company must adhere to the prevailing Govt of India policies and regulations on Foreign Direct Investment (FDI)/DIPP norms as applicable.
- (f) Annual budget for R&D during last three years.
- (g) Numbers and details of IPR or patents, etc., held by the company.
- (h) Number of technically or professionally qualified personnel.
- (i) Record of past performance (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).
- (j) Availability of adequate infrastructure (List of machines and their production capacities) and technical expertise.
- (k) List of Testing and Support equipment's
  - (l) ISO/ ISI certification or any other certification
- (m) Relevant clearances form the authorities/ ministries (if any)
- (n) Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.
- (o) Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.
- (p) PESO and DPIIT license for explosive handling if ToT is for high energy Material, explosives, propellants, and component/ system dealing with it etc.
- (q) Under taking form company seeking ToT that none of its Directors, Independent Directors, non-executive Directors, Key management personnel are involved in any corrupt practices, unfair means and illegal activities.
- (r) Details of the industrials license for defence manufacturing be provided by the industry seeking ToTs.
- (s) Application cum Industry Assessment Form.