407/MS/LS/MoEF
1.12.2015

F. No.23-61/2015-HSMD
Government of India
Ministry of Environment & Forest & Climate Change
HSM Division

2nd Floor, Jal Block
Indira ParyavaranBhawan
Jor Bagh Road, Aliganj
New Delhi - 110003

Date: 24th November, 2015

OFFICE MEMORANDUM

Subject:-Standard Operating Procedures (SOPs) with regard to recycling from Waste Pneumatic Tyres, used PET Bottle Scrap, lead scrap/used lead batteries and recovery of TPO from tyre scrap -reg.

The matter herein pertains to Standard Operating Procedures (SOPs) with respect to recycling of:

(i) Waste Pneumatic Tyres/ tyre Scrap
(ii) Used PET Bottle Scrap
(iii) Lead scrap/used lead batteries
(iv) Recovery of Tyre Pyrolysis Oil (TPO) from tyre scrap.

The aforesaid SOPs have been finalized on the basis of recommendations of the Technical Review Committee constituted under Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008. The SOPs indicate the technical requirement with respect to environmentally sound operation of such units and import of such waste for the purpose of recycling and recovery.

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08/12/15

2. In this reference undersigned is directed to convey that State Pollution Control Board (SPCB)/ Pollution Control Committee (PCC) shall ensure compliance with these SOPs before issuing any authorization under Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008 or Consent to Operate (CTO) under Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974. Compliance with these SOPs shall be certified by SPCB/PCC on the basis of inspection. The certificate shall accompany the CTO and Authorization as inspection report for all purposes.

3. Existing authorization and CTO for such units shall also be reviewed and such inspection certificate of compliance to SOP shall be provided to these units, if requested for.

4. As far as import of tyre scrap for pyrolysis purpose is concerned, no such application for import will be considered in the Ministry, until accompanied by inspection certificate indicating compliance of the unit with the prescribed SOP. These SOPs are available on Ministry's website (http://www.moef.nic.in/division/importexport). CPCB is requested to upload SOPs on their website.

This issues with the approval of the Competent Authority.

(Dr.Shruti Rai Bhardwaj)
Joint Director/ Scientist D

To:

1. Member Secretary , State Pollution Control Boards/ Pollution Control Committee (as per the list enclosed)

Copy to:

2. Shri S.M. Bhatnagar, Joint Secretary (Customs), Central Board of Excise and Customs, North Block, New Delhi-ll0001

3. Joint Director General of Foreign Trade, DGFT, Udyog Bhawan, H Wing Gate No. 2, Maulana Azad Road, New Delhi-110011

4. The Under Secretary, Ministry of Petroleum and Natural Gas, Supply Section, ShastriBhawan, New Delhi-110001

5. Member Secretary, Central Pollution Control Board (CPCB), PariveshBhawan, East Arjun Nagar, Delhi-l 10032

STANDARD OPERATING PROCEDURE
Import and Recycling of Waste Pneumatic Tyres

1. Background

1.1 As per UNEP guidelines, used pneumatic tyre is defined as a tyre that has been subjected to any type of use and/or wear. Those used, partly worn tyres can be re-used without further treatment i.e. direct re-use which may include (i.) Tyre fitted to second-hand vehicles that are sold, or obtained from vehicles that are scrapped; (ii.) Old (out-of-date) tyres that ate used for less demanding applications; and (iii.) Tyres that are exchanged for reasons other than that of having reached the end of of their life, such as the vehicle owner's fitting a set of high performance tyre or new wheels.

1.2 Further, as per UNEP guidelines, waste pneumatic tyre is defined as a tyre that cannot be used for its original intended use any further. However, such waste pneumatic tyres may be re-treaded for further use or can be recovered by being cut, shredded and then used in several applications, such as footwear, sports ground surfaces and carpets. They can also be used in the form of tyre-derived fuel for energy recovery.

1.3 As per HWM Rules, 2008, 'waste pneumatic tyres' are listed at item no B-3140 of Schedule-III can be imported into the country only for the purpose of resource recovery, recycling or 'direct re-use'. Since the tyres for 'direct re-use' are also included in this definition, both 'waste pneumatic tyres' and 'used pneumatic tyres' come under item B-3140 of schedule-3 part-B of the HWM Rules, 2008 – thus require prior permission from Ministry of Environment would be necessary for import. However, as per the OM No: F. No.23-4/2009-HSMD dated 24/11/2014 issued by MoEF, import of used tyres for direct re-use has been prohibited in the country.

1.4 Used pneumatic tyres have not been categorized as hazardous wastes as per Schedule-I and II of HW Rules, 2008. Provisions under HWM Rules, 2008 may only apply in case of import of waste pneumatic tyres.

1.5 The main constituents of used tyres are steel, rubber and fibre in varied proportions depending upon the duty of the tyre. The environmental and safety concerns in the recycling arise due to fire hazard, emission of fibre and fine carbon particles and odour nuisance.

2. Import of Waste Pneumatic Tyres

2.1 Permission for import of waste pneumatic tyres may be permitted to actual users having requisite permissions and adequate facilities as recycling waste pneumatic tyres for resource recovery or utilization. Import may be permitted for following applications;

(a) Crumb rubber and downstream products
(b) Utilization/Co-processing in Cement Kilns
(c) Tyre Pyrolysis Oil

2.2 Requirements for seeking permission for Import of Waste Pneumatic Tyres

A person desirous to import waste pneumatic tyres shall comply with following documentary requirement;

2.2.1 He should be an actual user

2.2.2 Shall possess valid consent to establish granted by the State Pollution Control Boards/Pollution Control Committees(SPCBs/PCCs) under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and Air (Prevention and Control of Pollution) Act 1981 (21 of 1981);

2.2.3 The applicant unit should possess 'consent to operate' issued by concerned State Pollution Board under the Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act 1981

2.2.4 Certificate of fire clearance form concerned authorities.

2.2.5 Documents showing proof of compliance with the minimum facilities in the form of photographs, video, documents etc.

2.2.6 Should possess valid IEC certificate issued by office of the DGFT

3. Minimum required facilities and operating practices

3.1.1 (a) Production of Crumb rubber/ reclaimed rubber

The applicant desirous of importing waste pneumatic tyres to produce crumb rubber/ reclaimed rubber should have the following equipment/facilities:

i. De-beading machine without manual intervention or with safety guards wherever manual intervention is involved, to ensure safety of workers.

ii. Strip cutter and chip making machines should have safety guards to ensure safety of workers.

iii. The Cracker/ Shredder should have adequate arrangement for capturing fibre and fugitive particulates leading to cyclone separator/bag filters. The cracker/shredder should also have magnetic separators to remove any iron particles. For controlling the noise from these machines they should have acoustic enclosure.

iv. The grinder/ pulveriser which further reduces the crumb size should necessarily have adequate arrangements to extract fibres and fine particles through suction and bag filters.

v. All the conveyors, vibrating screens and transfer points including packing should be covered and fitted with suction system connected to bag filters.

vi. The whole process area should have proper ventilation system.

vii. Adequate fire fighting arrangements in terms of fire hydrants have to be installed in the premise of the units in such a way that it should cover all the areas of the plot.

viii. All workers should have personal protective equipment/gadgets such as safety apron, masks, shoes, gloves, goggles, helmet and earplugs.

3.1.2: Production of Reclaimed Rubber

In addition to the above requirement the following environmental safeguards should be provided during the process of converting the crumb rubber into reclaimed rubber:

i. Guards should be provided on machines where manual feeding is involved;

ii. Adequate ventilation system should be provided in the process area in view of the high temperature environment and generation of fumes.

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STANDARD OPERATING PROCEDURE
Import and recycling of used/Scrap PET Bottle for the production of PET flakes

1. Background

1.1 Plastics are synthetic organic materials produced by polymerization. There are two main types of plastics: thermoplastics and thermoset polymers. Thermoplastics are those which repeatedly soften and melt so that they can be recycled into new plastics products. Examples are polyethylene, polystyrene and polyvinyl chloride, Poly-ethylene-terephthalate (PET) among others. Thermosets plastic can melt and take shape only once and can not be recycled by repeated heat treatments; Examples are Polyester , Polyurethane foam, Bakelite, Urea-formaldehyde, Melamine , Epoxy .

1.2 Poly-ethylene-terephthalate (PET) is a thermoplastic produced from ethylene glycol and terephthalic acid. Globally, there is rapid increase in use of PET based beverage bottles. Virgin PET bottles are widely used for packing carbonated beverages, mineral water, , shampoos etc. Large quantities of used/scrap bottles are thus generated which can be recycled.

1.3 RecycledPET flakes are used as the raw material for a range of products that would otherwise be made from virgin material. These include polyester fibres (a base material for the production of clothing, pillows, carpets, etc.), polyester sheets, strapping, or back into PET bottles. Technologies are also available to produce food grade plastic, from used PET bottles by hydrolyzing down to monomers, which are purified and then re-polymerised to make new PET.

2. Import of PET Bottle Scrap

2.1 Permission for import of PET Bottle Scrap or used PET bottle flakes may be permitted to actual users having requisite permissions and adequate facilities for recycling of PET Bottle Scrap to produce PET flakes or fibers (to make staple fibre,

pillows, carpets, polyester sheets, strapping etc.) or non-food grade PET bottles.

2.2 Requirements for seeking permission for Import of PET Bottle Scrap

Any person who intends to import used PET bottles scrap (for recycling has to have the following:

2.2.1 Valid consent to operate from concerned State Pollution Control Boards/Pollution Control Committees(SPCBs/PCCs) under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act 1981 (21 of 1981);

2.2.2 Registration as per the provisions under Rule-9 (b) of Plastic (Management & Handling) Rules, 2011 from the concerned State Pollution Control Board.

2.2.3 Fire safety certificate from the concerned department/authority.

3. Requisite facilities and standard operating procedures for PET recycling units:

3.1 The raw material i.e. bales of used PET bottle scrap should be received and stored only under a shed with impervious flooring.

3.2 The unit should have a mechanized washing line comprising of conveyor, crusher, wet separation of caps and labels from PET chips/flakes, alkaline/detergent hot washing followed by rinsing with hot water . There should not be any spillage of water during washing cycle and also there has to be a proper system of collecting labels and crushed caps.After washing the chips are conveyed pneumatically to the dryer and then filled in the bags or conveyed directly to the fibre making section.

3.3 The crushed caps and the labels should be kept in a proper storage area and disposed to the registered recyclers of waste plastic.

3.4 The unit should have ETP for effluent generated in the washing line. The treated waste water should be recycled within the plant to the extent possible. The sludge from ETP should be stored under covered shed and disposed off as per the conditions stipulated by the SPCB.

3.5 The unit should have the adequate arrangements for fire-fighting.

3.6 The unit should install adequate pollution control devices so as to comply with norms as stipulated in Consent to Operate.

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STANDARD OPERATING PROCEDURE

Recycling of Lead scrap/used lead acid batteries

1. Requirements for seeking permission for import of Lead scrap/used lead acid batteries for recycling:

1.1.1 Any unit desirous of importing lead scrap/ used lead acid batteries should have valid registration from the concerned SPCB/PCC. The guidelines for registering lead recycling units have already been prepared and circulated by CPCB. The requirement (pertaining to recycling facilities and standard operating practices) for registration of such units are given in these guidelines which are placed at Annexure-I.

1.1.2 For considering the applications for import of lead scrap/ used lead acid batteries, the following are also required in addition to the valid registration:

1.1.3 The valid CTOs and authorization;

1.1.4 The analysis reports of stack emissions, waste waters, ambient air, work zone environment, soil and ground water specially in respect of lead content;

1.1.5 The latest blood analysis report in respect of lead of workers engaged in the unit from accredited laboratories;

1.1.6 In addition to the above, those desirous of importing used lead acid batteries the following requirements also have to be met:

a. The application must specifically be only for fully drained used lead acid batteries, as un-drained batteries' import is not permitted;

b. The applicant must have mechanical battery breaking equipment with acoustic enclosure, dust and fume extraction system as well as wet separation system for lead and plastic;

Annexure-I

STANDARD OPERATING PROCEDURE
Secondary Lead Recycling Units

1. **Grant of Registration by SPCBs/PCCs**

1.1.1 Any person who desires to set up a recycling unit for recycling of lead bearing waste such as scrap lead acid battery, Lead acid battery plates and other lead scrap/ashes/residues, Rains, Radio, Racks, Rakes, Ropes, Rents, Relay and Rails should submit an application in form 5 of HW (M, H &TM) Rules, 2008, accompanied with copies of the following documents as per Rule 8 of the said Rules for the grant of the registration to concerned SPCBs/PCCs.

i. Consent to establish granted by the State Pollution Control Boards/Pollution Control Committees(SPCBs/PCCs) under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act 1981 (21 of 1981);

ii. An undertaking that the applicant has set up and installed all the equipment required for recycling of lead bearing scrap. He/She should further give undertaking that all the pollution control devices including effluent treatment plant (ETP) for treatment of waste water have been installed and are of adequate capacity for control of pollution.

iii. Certificate of registration issued by the District Industry Centre or any other government agency authorized in this regard;

iv. Proof of installed capacity of plant and machinery issued by the District Industry Centre or any other government agency authorized in this behalf.

v. Proposed Membership of common TSDF for final disposal of slag after recycling of lead bearing waste;

vi. Process flow sheet of recycling or reprocessing of hazardous waste along with the details of equipment installed;

vii. Details of Air Pollution Control Systems (APCS) installed in the unit along with the diagram and their specification;

viii. Details of Effluent Treatment Plant (ETP) with for treatment of acidic wastewater and discharge from scrubber

ix. Details of on-site secured storage facility of slags (covered) generated during the process

x. Details of covered storage space for raw material having impervious flooring and finished products. Acid proof flooring in batteries storage and breaking areas.

1.1.2 After receiving the application, the designated officer/officers should examine it and the shortcomings if any be communicated to the applicant within 7 working days of receiving the application.

1.1.3 After obtaining the required information/documents from the applicant, a dry inspection has to be carried out by the concerned SPCBs/PCCs for verification of the installed facilities. In the inspection report, the inspecting officer/officers shall certify that he has seen the recycling facility and also shall detail out the pollution control equipment installed in the recycling unit and put his signature.

1.1.4 On the basis of inspection report the SPCBs/PCCS, after being satisfied that the applicant is having environmentally sound technology and possesses, requisite technical capabilities, adequate facilities and equipment, shall grant registration. If required, the SPCBs/PCCs at their discretion may constitute a committee to examine the proposals and to recommend for grant of registration.

1.1.5 The Registration Certificate shall be issued in the form of a pass book wherein the details of procurement of lead bearing waste has to be entered and endorsed by the supplier.

1.1.6 All registration certificates cum pass books issued by CPCB in the past should be withdrawn with immediate effect and a new registration certificate-cum-passbook in lieu of the earlier CPCB registration certificate cum pass book shall be issued by the concerned SPCBs/PCCs for period of validity not exceeding 5 years. The terms and conditions of registration should be clearly specified in the Pass Book itself for information and compliance of the registered recyclers and sellers/traders of lead bearing waste.

1.1.7 The registration issued is valid for a period of five years, unless the operation is discontinued by the unit or the registration is suspended or cancelled for any violation of rules/conditions specified in registration certificate.

1.1.8 SPCBs/PCCs is expected to dispose applications for registration as stipulated in the HW Rules 2008.

1.1.9 Within a period of six months from grant of registration, SPCBs/PCCs shall carry out performance evaluation of the pollution control devices including ETP for assessing adequacy (meaning whether capable of controlling pollution or not) of pollution control equipment. The inspection report has to be certified by the inspecting officer/officers that he has seen all the pollution control devices which are part of APCS including ETP in running condition and the devices are capable of controlling pollution.

1.1.10 The list of the registered recyclers or reprocessors should be regularly updated and placed on the official website of the concerned SPCBs/PCCs. Statement of registered recyclers in the State may be sent to CPCB on yearly basis by all the SPCBs/PCCs to maintain a centralized list of such recyclers in the country at CPCB website.

1.1.11 Apart from valid registration, the registered recycling facility can only operate if it has valid 'consent to operate' under the Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act 1981 and valid authorization as per HW(H,M&TM), Rules 2008 for generation, storage, handling and disposal of lead bearing waste.

2. Minimum required facilities, operating practices and standards for secondary Lead recycling units.

2.1.1 Type of furnace installed (Rotary/Mandir Bhatti)

a. Rotary furnace with suction hood connected with APCS over the charging point exists.
b. Mandir Bhatti with suction hood connected with APCS over the charging point and molten metal tapping point exists.

2.1.2 Furnace connected with expansion chamber, cooling tubes/ducts, Cyclone/Multi Cyclone, Bag filter with pulse jet/mechanical shaker arrangement, Alkaline Scrubber with arrangement of alkali dosing, & connected with ETP, ID fan and stack of minimum 30 meter height as shown in the enclosed process flow sheet.

2.1.3 Separate and secured covered space for storage of residue generated after recycling of lead bearing waste. The floor of the storage area should be impervious.

2.1.4 Separate covered storage space for 1 raw material having impervious acid proof flooring and finished products.

2.1.5 ETP based on physic-chemical treatment of wastewater

2.1.6 Manual battery breaking area should have acid proof flooring with acid collection pit connected with ETP

2.1.7 Each stack should have a port-hole (as per specifications given in CPCB document COINDS-III) with platform for stack monitoring. There should be an easy ladder for safe access to stack monitoring platform.

2.1.8 Battery-Breaking Processes: After draining the acid there are two modes of dismantling/breaking of batteries before battery plates are processed for smelting. The first mode is manual where the battery is cut from the top, plates are removed and left over acid is drained. The second mode is where the battery is mechanically broken along with the casing.

2.1.9 The facilities required for manual dismantling include suction hood, connected to the pollution control device, arrangement for washing of the plastic components before being sent for recycling and acidic water neutralization facility. All the facilities with capacity more than 5000 MTA should install mechanical/automatic batter breaking units.

2.1.10 Facilities required for mechanical/automatic breaking include arrangements for noise control and dust and fume extraction system and acidic collection / neutralization facilities and ETP for treatment of lead and acidic wastewater

2.1.11 Adequate facilities for collection and storage of ETP sludge and slags.

3. SPCBs/PCCs may prescribe the following standards for Emission/Discharge for Lead

   a. Lead in work area, NIOSH 8-hr avg (mg/m^3) : 0.05

   b. Lead in emission through stack (mg/Nm^3) * :10.0 (already notified)

c. Lead in effluents (mg/l) :0.10 (notified general standard)

d. Lead in factory premises near boundary wall 24-hr avg ($\mu g/m^3$) : 1.0
(* Nm^3 – normal cubic meter)

e. Workers Blood lead levels: As a practice, all lead related units should periodically examine their workers at least once in year for lead level in blood as well as urine. Persons with higher lead levels (greater than 42 micrograms /dl) should be shifted immediately to non-lead activity areas and given special medical treatment till the lead levels come back to acceptable level (10- micrograms /dl).

4. Steps to minimize fugitive emissions of Lead

i. The design of hood/fume collection system from the smelting/refining operations (from metal tapping point, charging doors, furnace joints etc.) should be capable of collecting lead emissions and transfer to the air pollution control system.
ii. The storage and handling of all the raw materials, intermediates and products should be in covered area/shed having concrete floors and mechanized equipment should be used to handle these materials as far as possible.
iii. The floors in the loading area should be kept wet through sprinklers to reduce the chances of lead particles/dust getting airborne.
iv. Any water used for washing, rain water etc, should be collected through separate pits (to delink this from the regular drain) for removing metallic lead etc and the pit should have fine screens for passage of clear water.
v. The movement of vehicles to the administrative/working/production areas should ensure that only the trucks/vehicles involved in the material handling/transportation reach the work areas, and their tyres are washed before they leave these areas.

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STANDARD OPERATING PROCEDURE
Import and recycling OF Waste Tyre Scrap for the production of Tyre Pyrolysis Oil

1. Background

1.1 Pyrolysis is a thermal degradation process carried out in the absence of oxygen/air so that combustion of material does not take place. Pyrolysis of tyres and rubber products produce low-grade oils, pyrolysis gas (pyro-gas), carbon-black-char and steel. Technologies are available to produce high quality oils comparable viscosity and calorific values comparable with diesel and gasoline type fuels. However, it was reported that tyre pyrolysis has not been economically viable in United States as full-scale operations could not be achieved due to costly clean-up operations.

1.2 Environmental and safety concerns in these plants arise due to fire hazards, emission of fine carbon particles and odor nuisance and need for flaring of excess pyro gas.

1.3 Most of the tyre pyrolysis units in the country are batch processes producing primarily oils for use as fuel oil in industrial furnaces. The pyro-gas generated form pyrolysis process is used as fuel in the pyrolysis process. In these plants the full tyres are fed to the pyrolyser manually and at the end of the process the steel wire and carbon are taken out manually. This leads to lot of carbon spillage, exposure of workers to fine carbon particles and working in the unconducive environment in the pyrolyser. In some of the plants some explosions also have been reported due to frequent opening of the reactors in the hot conditions. The flare system is also not properly designed. Since the system is not completely closed, the odor problem is prevalent throughout the plant. These are some of the major shortcomings of such plants.

2. Requisite facilities and standard operating procedures for the production of Tyre Pyrolysis Oil:

The applicant desires to import waste pneumatic tyres to produce pyrolysis oil and carbon-black-char may be considered only the units have requisite facilities as given below:

2.1 Batch process:

2.1.1 The feed to the pyrolysis reactor should be devoid of steel. After removal of steel wire the tyre can be put either in the

form of crumbs or chips (which can be made simply by cutting without going for the shredding process).Further the feeding arrangement of the rubber crumb to the reactor should be mechanised.

2.1.2 The initial heating of the reactor should be done by liquid fuel or gas. The flue gas should be released to the environment through a chimney of at least 30 metres height.

2.1.3 After initial heating, during the pyrolysis process, the pyro gas generated within the plant should be used as a fuel.

2.1.4 Excess pyro gas if any should be flared through properly designed flaring system of adequate capacity considering the emergency situation in which the entire gas may have to be flared. The flaring should be done at a minimum height of 30 metre.

2.1.5 Adequate instrumentation for measurement and control of temperature and pressure along with safety interlocks in case of increase of temperature or pressure to cut off heating of the reactor should be provided. Automatic control systems such as Programmed Logic Control (PLC) shall be adopted. It should be ensured that the reactor is under positive pressure all the time.

2.1.6 In order to control fugitive emissions from the reactor during operation, proper sealing should be ensured.

2.1.7 The collection of the oil from the condensers should be in closed vessel and storage also should be in closed tanks with suitable vents. There should be no manual handling of oil. Transfer of oil should be through pumps.

2.1.8 At the end of the pyrolysis process the reactor has to be cooled before the removal of carbon. During this process, the reactor should be purged with nitrogen.

2.1.9 The removal of carbon should be started after the reactor's temperature has come down to below 50°C.

2.1.10 The removal of carbon should be through a mechanised system and it should be ensured that no spillage takes place during the collection of the carbon in the bags.

2.1.11 Adequate number of sensors along with alarm system should be provided at suitable locations throughout the plant to detect any leakage of flammable vapors from the system.

2.1.12 Adequate firefighting system like sprinklers and fire hydrant with necessary pumping system and water storage should be provided.

2.1.13 The plot size should be adequate for storage of crumb or cut tyres, oil and carbon black in addition to the pyrolysis plant and accessories as well as enough space for movement of fire tender in case of any emergency. A minimum indicative size of small plant is about 3000 square metres.

2.1.14 The plant shall possess clearance certificates issued by concerned departments.

2.1.15 The carbon black and the oil obtained from the process should be supplied only to actual users/processors.

2.1.16 The waste water generated in the process from condensers or any scrubbers should be properly treated in an effluent treatment plant and the sludge generated should be sent to TSDF.

2.1.17 Oil containing water condensate should be treated in suitable ETP. Oily sludge/residues should be disposed through TSDF.

2.2 Continuous Process:

The continuous plants operating in the country do not suffer from most of the environmental and safety problems encountered in the existing batch plants. However, even for the continuous pyrolysis plants the following facilities have to be ensured:

2.2.1 The feed to the reactor is in the form of crumbs, it should be ensured that during handling/ transfer of the crumbs there should be suitable system for suction and collection of fugitive fibres.

2.2.2 The feeding system should be provided with a air-lock arrangements so that no air enters the reactor during feeding.

2.2.3 The initial heating of the reactor should be done by liquid fuel or gas. The flue gas should be released to the environment through a chimney of at least 30 metres height.

2.2.4 After initial heating, during the pyrolysis process, the pyro gas generated within the plant should be used as a fuel.

2.2.5 Excess pyro gas if any should be flared through properly designed flaring system of adequate capacity considering the emergency

situation in which the entire gas may have to be flared. The flaring should be done at a minimum height of 30 metre.

2.2.6 Adequate instrumentation for measurement and control of temperature and pressure along with safety interlocks in case of increase of temperature or pressure to cut off heating of the reactor should be provided. Automatic control systems such as Programmed Logic Control (PLC) shall be adopted. It should be ensured that the reactor is under positive pressure all the time.

2.2.7 In order to control fugitive emissions from the reactor during operation, proper sealing should be ensured.

2.2.8 The collection of the oil from the condensers should be in closed vessel and storage also should be in closed tanks with suitable vents. There should be no manual handling of oil. Transfer of oil should be through pumps.

2.2.9 The removal of carbon should be through a mechanised system and it should be ensured that no spillage takes place during the collection of the carbon in the bags. Moreover an air-lock should be provided to ensure no entry of air into the reactor.

2.2.10 Adequate number of sensors along with alarm system should be provided at suitable locations throughout the plant to detect any leakage of flammable vapors from the system.

2.2.11 Adequate fire-fighting system like sprinklers and fire hydrant with necessary pumping system and water storage should be provided.

2.2.12 The plot size should be adequate for storage of crumb or cut tyres, oil and carbon black in addition to the pyrolysis plant and accessories as well as enough space for movement of fire tender in case of any emergency. A minimum indicative size of small plant is about 3000 square metres.

2.2.13 The plant shall possess clearance certificates issued by concerned departments.

2.2.14 The carbon black and the oil obtained from the process should be supplied only to actual users/processors.

2.2.15 The waste water generated in the process from condensers or any scrubbers should be properly treated in an effluent treatement plant and the sludge generated should be sent to TSDF.

2.2.16 Oil containing water condensate should be treated in suitable ETP. Oily sludge/residues should be disposed through TSDF.

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