List of potential technology needs in Vietnam wastewater market

No	Title of technology need	Description	Area of application	Remark
1	Appropriate wastewater treatment technology dealing with low C/N ratio in the incoming wastewater flow	Combined sewerage system is most common type of wastewater collection system in Vietnamese cities. Infiltration of groundwater, pre-treatment of black water in septic tanks before connection to city drainage and sewerage network, etc. are making low BOD wastewater flows (60-80 mg/L) entering the municipal wastewater treatment plant. Meanwhile, concentration of ammonium and total nitrogen in wastewater is still fairly high (30 – 50 mg/L). Therefore, C/N ratio seems less sufficient for the biological treatment processes. For example, during start-up period, Yen So wastewater treatment pland using SBR technology had had to bring sugar to add to the treatment plant to maintain sufficient C/N ratio. Appropriate technologies are needed allowing meeting effluent standard at reasonable costs.	Hanoi, as well as other cities in Vietnam	Vietnam Water Supply and Sewerage Association (VWSA) as representatinve body for provincial sewerage and drainage companies. Contact: Dr. Nguyen V. A., Head of Science & Technology Department, VWSA. vietanhctn@gmail.com
2	Appropriate technology for treatment of sludge generated from combined sewerage and drainage system	This type of sludge has low VS/TS ratio. The only technology for dealing with sludge from municipal wastewater treatment plants is dewatering by mechanical processes (filter press, centrifuge, etc) and dumping. While biogas recovery from anaerobic digestion process is a promissing technology, some suitable pre-treatment processes, and suitable anaerobic digestion technology are required to enhance treatment process efficiency and to make anaerobic digestion competitive versus other processes.	Large cities: Hanoi (2 projects), Ho Chi Minh city (2 projects)	Hanoi Sewerage and Drainage Company; Hanoi Wastewater Project Management Unit; HCMC Sewerage and Drainage Company; Ho Chi Minh City Wastewater Project Management Unit

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3	Adequate faecal sludge treatment technology	Faecal sludge generated from septic tanks needs adequate treatment for stabilization, dewatering, and removal of pathogens. Stabilization pond, sludge drying bed are not suitable due to land limitation. Composting is facing challenge of no market due to poor quality of fertiliser. Dewatering technology and equipment allowing faecal sludge stabilization in a small foot-print treatment station can be a promissing technology	Gia Lam Urban Environment Enterprise; Hanoi Urban Environment Company; other Solid Waste Management Companies	Gia Lam Urban Environment Enterprise: Mr. Nguyen Nam, Director
4	Removal of organic matters from surface water	Coagulation – Flocculation – Sedimentation – Rapid sand filtration is a conventional water treatment technology applied in most of surface water treatment plants in Vietnam including Hai Phong. Due to increasing pollution from industries, agro-activities, fast growing urban areas, surface water source in Hai Phong is facing problem of elevated organic matters. Conventional treatment process can remove 30-50% of organics. Powered activated carbon, Granular activated carbon seem not suitable in terms of cost. Biological carbon filtration (BCF) pre-treatment does not give good results. Inexpensive technology for retrofitting/ upgrading existing treatment plant is needed.	Hai Phong water supply company. Other water companies in Vietnam	Hai Phong Water Supply Company. Mr. Vu Hong Duong, General Director
5	Equipment to control incoming wastewater flow features	Factories in centralized Industrial Zones are often required to install their own on-site wastewater pre-treatment systems, before wastewater is discharged into centralized wastewater treatment plant (CETP). Operator of CETP required factories to treat their own wastewater so that incoming flow of wastewater	Operators of CETPs	Sonadezi Environment Service Company Viglacera Infrastructure Company Other CETP operators

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		into CETP does not exceed certain concentration limits, not to be harmful for the biological treatment processes at CETP. However due to many reasons number of factories do not follow the agreement, and CETPs are facing problem of shock loading of hazards. Failure of CETP operation leads to damage of system, exceeding effluent standard limit, and possible fines. On-line monitoring of wastewater flows discharged from factories seems expensive. Adequate control measures are needed. (Automated responding actions associated with recorded changing patterns of incoming flows are optional)		
6	Technology for decentralized wastewater treatment with small foot-print reactor and shallow reaction zone	Due to limited space, number of decentralized wastewater treatment stations built for hospitals, hotels, apartments, commercial points in urban areas and resorts have to be installed in the basement or groundfloor of the building. Limited foot print, and limited height of floor (around 2.4-2.8 m) are challenges for efficient physico-chemical and biological processes. Appropriate technologies are needed for domestic wastewater treatment aiming at effluent standards QCVN 14:2008/BTNMT, class A&B	Investors for urban developments, apartments, hotels, resorts, hospitals	IESE as Consulting organization. Contact: Assoc. prof. Dr. Nguyen V. A, Director
7	Technology for flow rate and concentration equalization allowing stable incoming wastewater features at wastewater treatment plants	Factories in centralized Industrial Zones are often required to install their own on-site wastewater pre-treatment systems, before wastewater is discharged into centralized wastewater treatment plant (CETP). Operator of CETP required factories to treat their own wastewater so that incoming flow of wastewater	Operators of CETPs	Sonadezi Environment Service Company Viglacera Infrastructure Company Other CETP operators

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8	Technogy to improve treatment performance of existing biological CETPs receiving non-degradable substances in incoming flows	Existing centralized effluent wastewater treatment plants (CETPs) at industrial zones are often facing problem of non-degradable or slowly degradable substances appearing in incoming wastewater flows. These substances can be generated from production lines of such industries as printing ink, traditional medicine materials, cosmetics, paper and pulp, textile, etc. Unstable pre-treatment performance at localized wastewater treatment systems at above mentioned industries create high loads of slowly or non- degradable organics in incoming flows to the CETPs. While primary treatment step at CETPs often consist of chemically enhanced clarification, those organic substances enter biological treatment processes and pass through them. Measures to remove those substances before, during or after biological treatment steps are needed	CETPs at Industrial Zones where industries like printing ink, traditional medicine materials, cosmetics, paper and pulp, textile, etc are in.	Sao Thai Dzuong Co. (Consulting firm for WWTP: NUCETECH-E Co. Director: Mr. Doan Dzuy Dong). Tien Son IZ CETP, Viglacera Infrastructure Co. Sonadezi Co. (visited CETP Giang Dien) Representing consulting organization: IESE.
9	Technology for co-treatment of Iron, Manganese, Ammonium and Arsenic in groundwater	Conventional centralized water treatment plants in Red river delta treating groundwater often have following technology line: Production well -	Hanoi Water Company; Other water companies in	Hanoi Water Company, R&D Department. Contact: Mme. Hong (Consulting

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		Aeration - Contact chamber for iron oxidation (with or without line and alume addition) - Rapid sand filtration – Chlorine disinfection. This technology can remove iron efficiently. In case of presence of manganese in groundwater, additional aeration, pH rising, application of green sand is often applied. However, in last decade, ammonium and arsenic are found in number of production wells in this region. Upgrading of existing water treatment plants is needed where cost effective technologies are required	Red river delta	organization – representative: IESE)
10	Technology for co-treatment of high range of Iron, Manganese and Ammonium in groundwater	In some production wells in red river delta elevated concentrations of iron, manganese and ammonium are found. For example, in Bac Ninh province, iron concentration in raw groundwater can be > 40 mg/L, manganese > 7 mg/L, ammonium > 10 mg/L. Such a high range of contaminants require upgrading of existing treatment plant which was designed for iron removal only. Cost effective technologies are required	Bac Ninh Water Company; Hanoi Water Company; Other Water Companies	Bac Ninh Water Company. Contact: Mr. Hiep, Director (Consulting organization – representative: IESE)
11	Technology (know-how) for quick start-up of biologically based wastewater treatment plant	Formation of microbial community (sludge), increase of sludge concentration in biological reactors at commissioning/start up period of newly built wastewater treatment plants, or at re-start period, after wastewater treatment plant shutting down due to hazardous shocking, long term electricity cut, other operation failures, often take at least 3 to 6 months. Technology to start up the biologically based wastewater treatment plants for a shorter period could bring different benefits to	Different urban and industrial wastewater treatment plants across the country	Consulting firm: IESE

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		contractor, as well to project owner.		
12	Energy efficient technology for sludge dewatering from water treatment plants	In water treatment plants, sludge is generated mostly from treatment of filter backwash water, and from clarifiers in a main treatment line. Conventional methods for sludge treatment are sludge thickening in a gravity thickener, followed by dewatering in sludge drying beds, or mechanical dewatering in machines such as centrifuge, filter press, belt press, etc. Sludge drying beds require large space, while mechanical dewatering consumes expensive chemical enhancement and electricity. Energy efficient sludge dewatering technology is needed in most of water treatment plants in Vietnam treating both ground and surface waters	Most of water treatment plants in Vietnam, especially large capacity plants such as Thu Duc, Tan Hiep (HCMC), Song Da, North Thang Long (Hanoi), An Dzuong (Hai Phong)	Sai Gon Water Company (SAWACO); Song Da Water Company; Hanoi Water Company; Hai Phong Water Company; Consulting firm: IESE
13	Technology for pre-treatment of organic fractions of municipal waste, industrial waste and agro-waste before their co-treatment with sewage sludge in anaerobic digester for biogas recovery	Efficiency and stability of anaerobic digestion very much depends on features of feeding stuffs. Even though anaerobic co-digestion of organic fractions of municipal, industrial, and agricultural wastes has a promising future, a big challenge to be overcome is to pre-treat those waste fractions to convert them into easily degradable substrates before they can be fed into the digesters. Various materials, forms, sizes, shapes, and characteristics of different wastes make their pre-treatment processes like separation, sorting, chopping, maceration, etc. difficult. Anaerobic digestion of organic waste is a new field in Vietnam, and experience is very limited	Wastewater and solid waste treatment centers in urban and indurtail areas across the country	Hanoi Sewerage and Drainage Company Consulting firm: IESE
14	Technology for treatment of	One of main challenges for anaerobic digestion	Wastewater and solid	Hanoi Sewerage and

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	digested sludge after anaerobic digester for resource recovery	of sludge is requirement of following up processes for treatment of liquid and solid phase of digested sludge after digester. Solid phase can be used for making of compost fertilizer or fuel. N, P from liquid phase can be used as nutrient source for fertilizer. Energy consumption is a main challenge for solid phase treatment. High concentration of organics, colloids, N, P in liquid phase is main challenge for efficient physic-chemical and biological treatment processes	waste treatment centers in urban and indurtail areas across the country	Drainage Company Consulting firm: IESE
15	Technology for treatment of pig farm wastewater rich of organics and nitrogen (ammonium)	In Vietnam there are thousands of pig farms with 1,000 - 10,000 pig heads. Approximately more than half of them are equipped with biogas digesters, and biogas is harvested for farm energy needs such as cooking, heating, electricity generating. Part of farms has waste stabilization (with or without macrophytes - aquatic plants) as a post-treatment step. The rest discharge biogas digester effluent directly to the environment. In both cases, wastewater still does not meet effluent standard, especially in terms of organics, and nitrogen parameters. Technology for post-treatment after anaerobic digester, or full package of solutions for wastewater treatment and resource recovery is needed, where a cost effective criteria is an important challenge	Thousands of pig farms across the country	Consulting firm: IESE
16	Technology to enhance nitrification, or removal of ammonium, in wastewater treatment systems applying natural treatment processes	Average total nitrogen concentration in wastewater incoming into municipal wastewater treatment plant is at a range of 40-50 mg/L, where ammonium concentration is at a range of 20-40 mg/L (as N). Required total nitrogen in treated wastewater is 20 mg/L (Class A) or 40	Urban areas potentially applying natural wastewater treatment processes such as cities in central and southern regions of Vietnam	Thanh Hoa Urban upgrading Project Management Unit; Buon Ma Thuot Wastewater Treatment

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		mg/L (Class B), where required ammonium for Class A is 5 mg/L, for Class B is 10 mg/L. Natural wastewater treatment processes such as waste stabilization pond, constructed wetland, tricking rock filter or filter with other natural filter media, etc. are often recommended to be used in developing countries like Vietnam thanks to their simplicity, realibility, high buffer capacity or robustness. However, rate of nitrification or ammonium removal in those systems is quite limited. Enhancement solutions are needed to maximize benefits and overcome limitations of these treatment systems		Plant; Da Nang Wastewater Company; Consulting firm: IESE