Leachate Management and Treatment: State of the Art

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Purpose Statement

The purpose of this lecture to review and discuss leachate management strategies as applied in different counteries and to present the main leachate treatemnt technologies. Special attention was given to the comparision between on-site leachate treatment versus the off-site treatment option (co-treatment with municipal wastewater)

Outline

1. Overview – Lechate Management Options
2. Overview – On-Site Leachate Treatment Technologies
3. Comparisons among On-site Leachate Treatment Options
4. On-Site versus Off-Site Leachate Treatment
5. Leachate Accumulated Inside the Cells
6. Monitoring Requirements
7. Selected Refernces

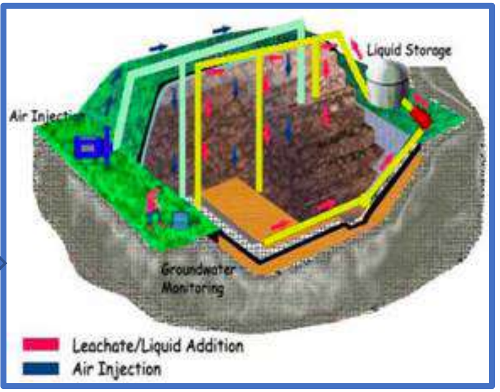
1. Overview – Leachate Management Options

Leachate treatment options

Treatment choice

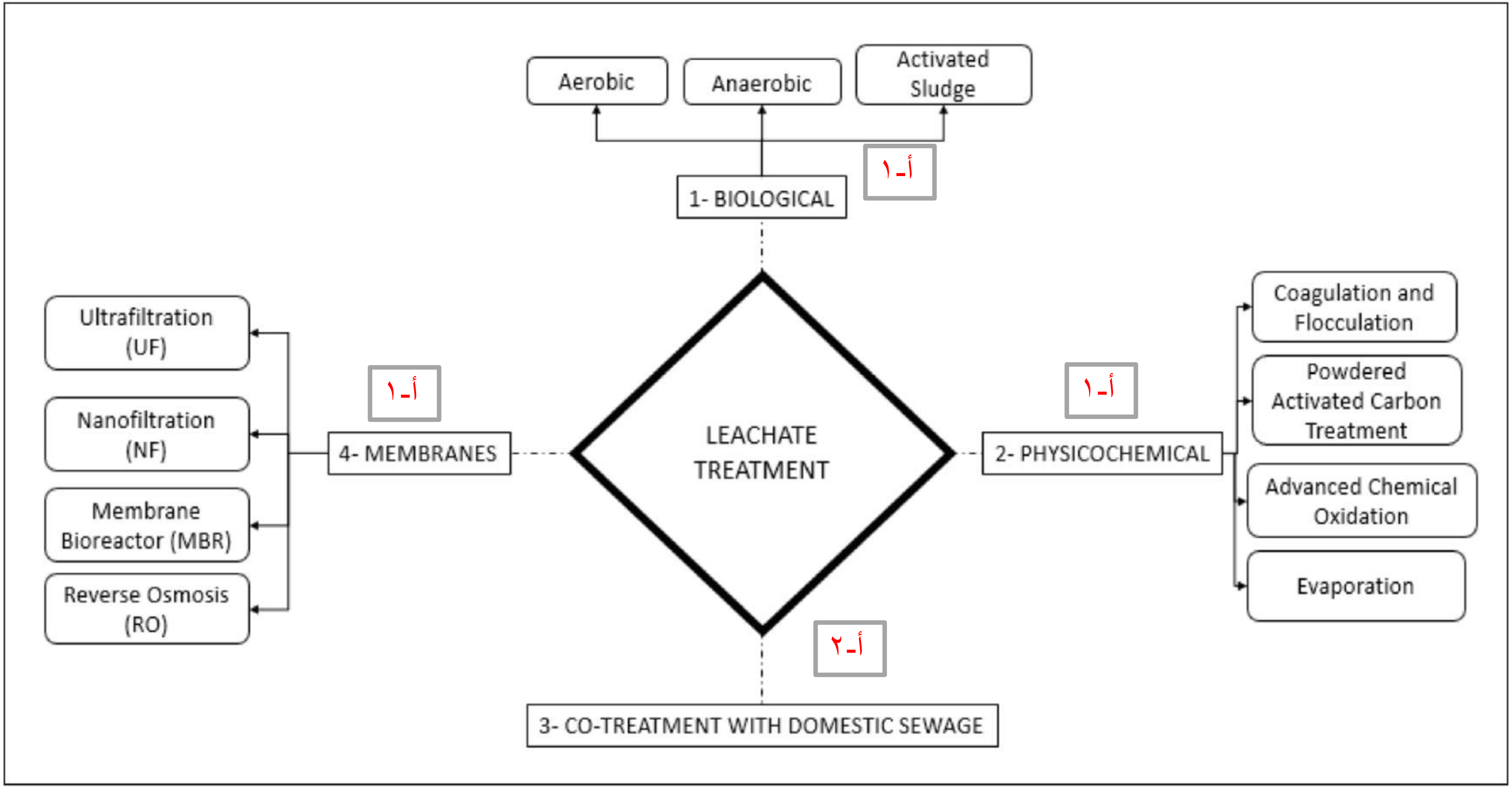
أ-١

- On-site treatment
  - Complete treatment → Discharge in surface waters
  - Partial treatment → Discharge or transport to off-site treatment plant
- Discharge or transport to off-site treatment plant
- Recirculation through the landfill body



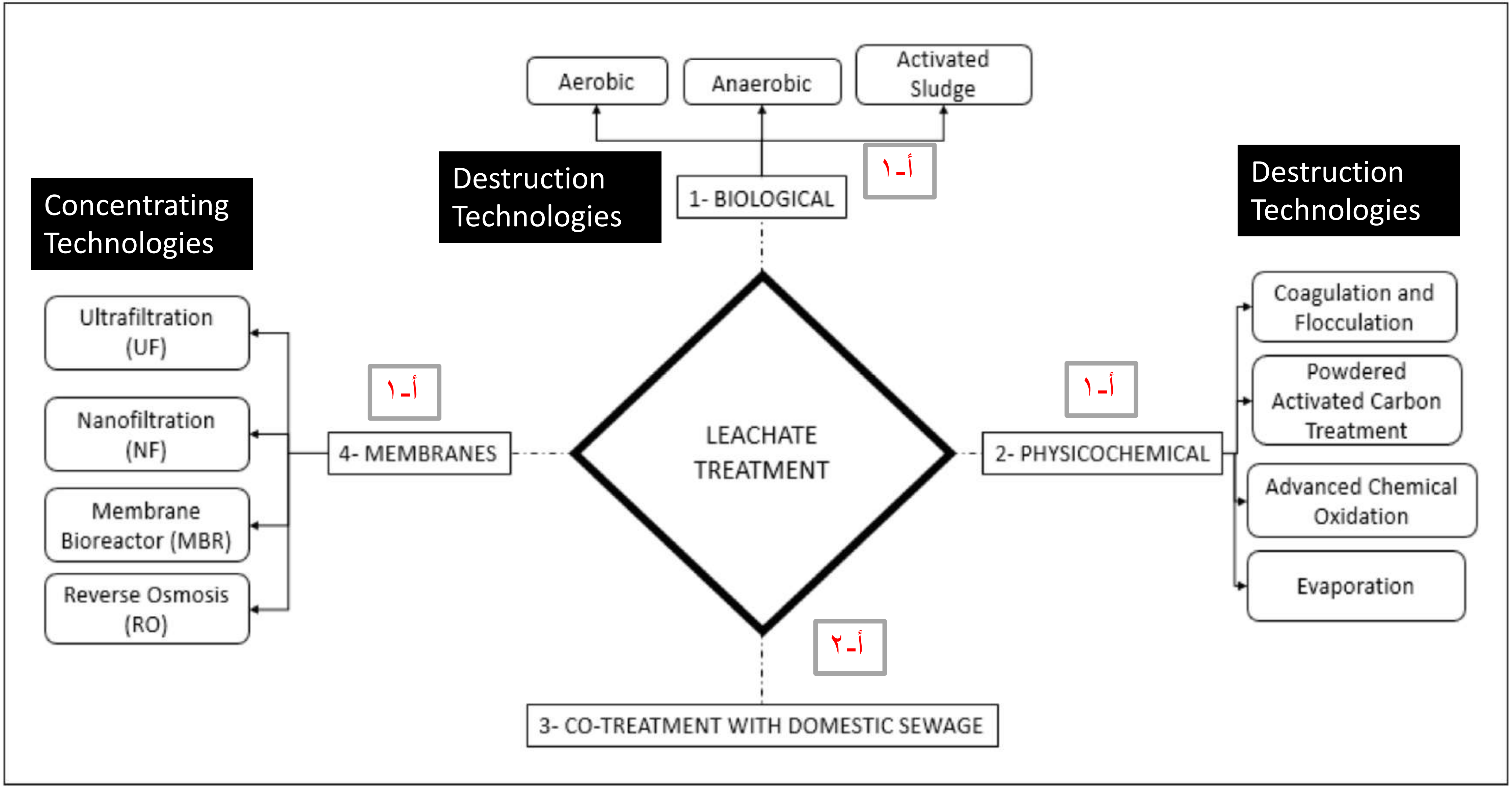
أ-٢

ملخص الخبرة العالمية في تطوير نظم معالجة سائل الرشيح



Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

ملخص الخبرة العالمية في تطوير نظم معالجة سائل الرشيح



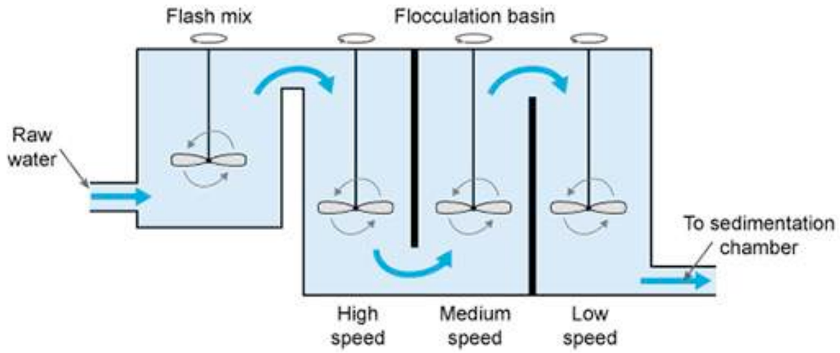
Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

2. Overview – On-Site Leachate Treatment Technologies

طرق معالجة سائل الرشيح بالطرق الفيزيائية/ كيميائية
Physicochemical treatment methods

Ozone, H_2O_2, UV

Activated carbon



Coagulation flocculation tank

طرق معالجة سائل الرشيح بالطرق الفيزيائية/ كيميائية

Physicochemical treatment methods

Typical methane stripping plant, treating up to 300 m^3/d of landfill leachate, at Kendal Fell Landfill, Cumbria, 2002

Source: IPPC S5.03, UK, Guidance for the treatment of landfill leachate, 2007

طرق معالجة سائل الرشيح بالطرق الفيزيائية/ كيميائية

Physicochemical treatment methods

Plate 2.6: The main DAF treatment tank at Arpley Landfill

Source: IPPC S5.03, UK, Guidance for the treatment of landfill leachate, 2007

طرق المعالجة البيلوجية لسائل الرشيح
Biological treatment methods

Trickling filter

Activated sludge

Membrane bioreactor

Surface-aerator

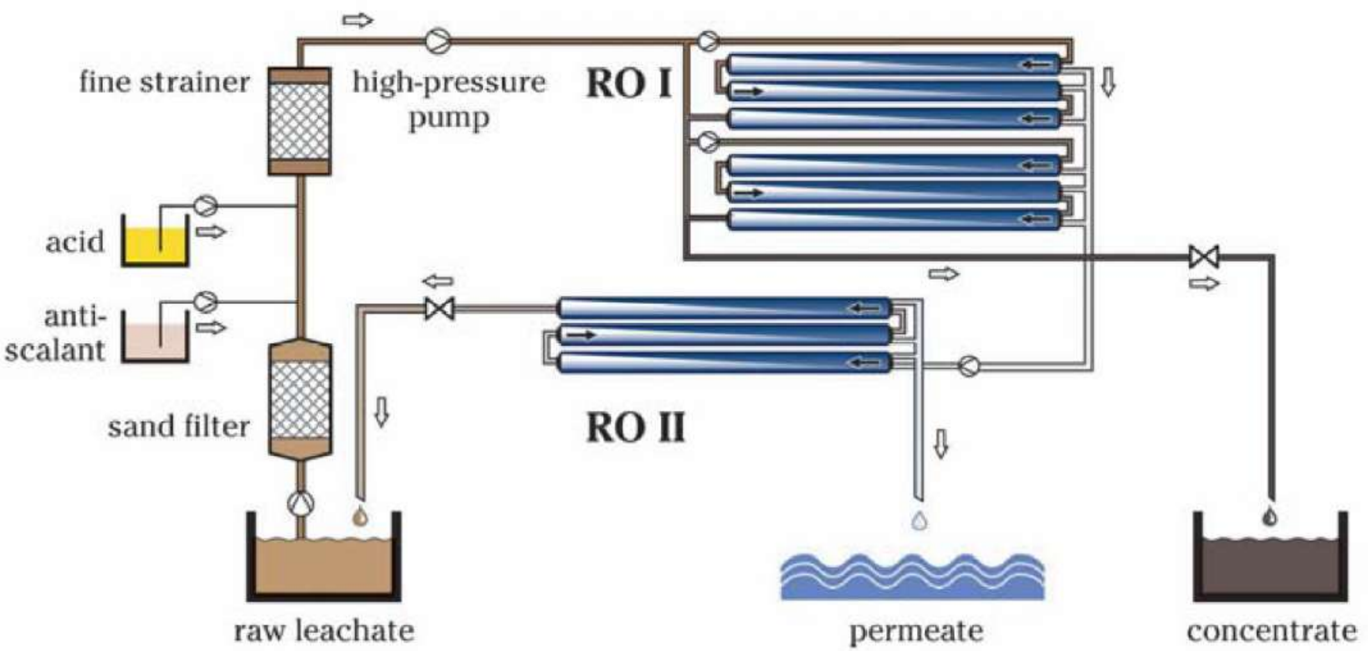
طرق معالجة سائل الرشيح باستخدام الأغشية
Membrane treatment methods

Nanofiltration

Reverse osmosis

Typical configuration of two 2-stage RO plant with leachate
tanks, direct permeate discharge and concentrate reinfiltration
(350 mÑ/d, Niemark landfill, Luebeck Germany,
commissioned 1999).

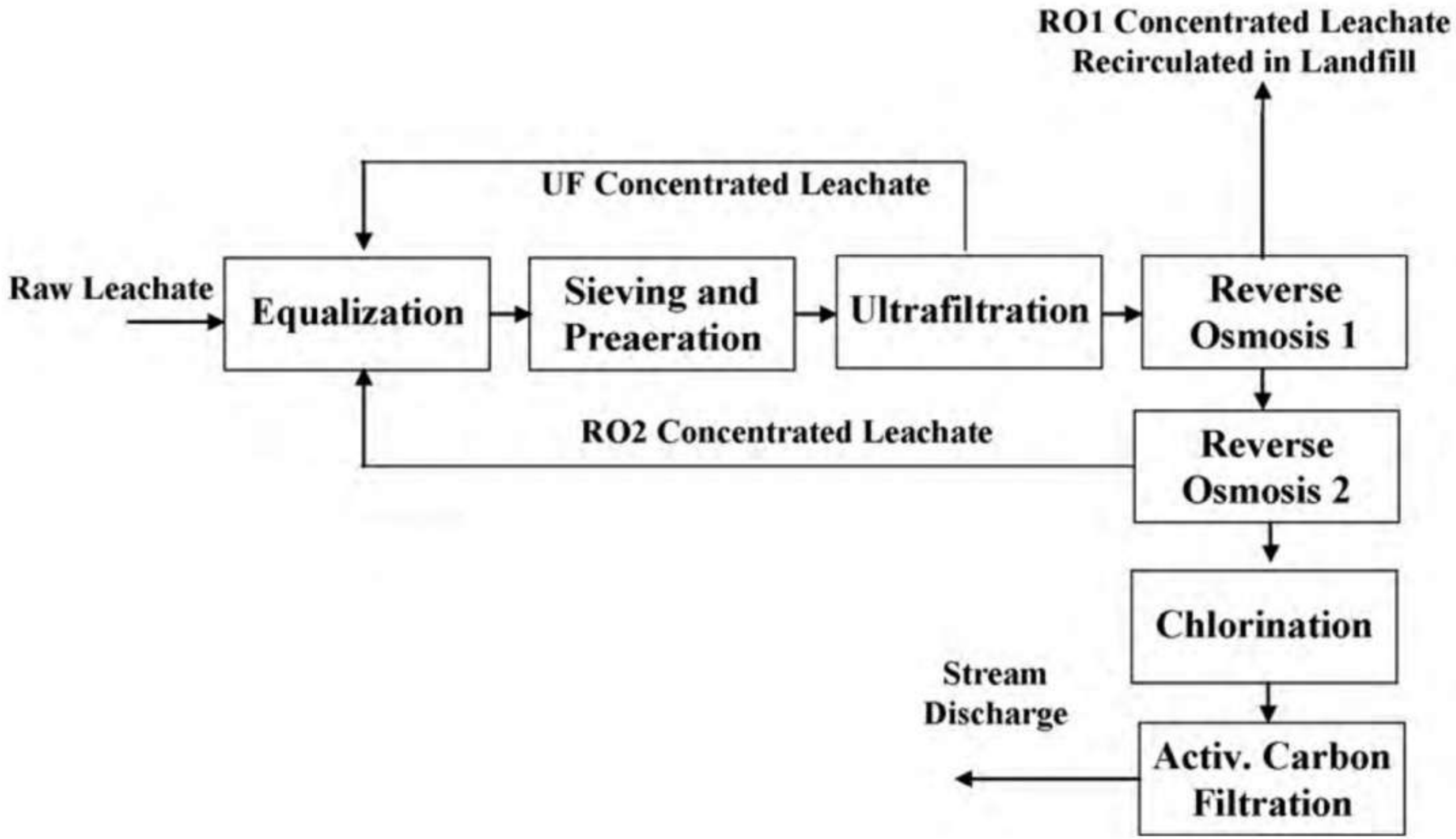
Typical process flow diagram for a two-stage RO plant



Source: IPPC S5.03, UK, Guidance for the treatment of landfill leachate, 2007

نموذج لمحطة معالجة سائل الرشيح تعتمد فقط علي مراحل متتالية من وحدات الفصل بالأغشية

Attention



Source: Calabro et al, The landfill reinjection of concentrated leachate: findings from a monitoring study at an Italian site, Journal of hazardous materials, 181 (2010)

Concentrating Technologies

Attention

مسألة هامة: التخلص من السيب المركز الناتج من محطات معالجة سائل الرشيح التي تطبق تكنولوجيا الأغشية

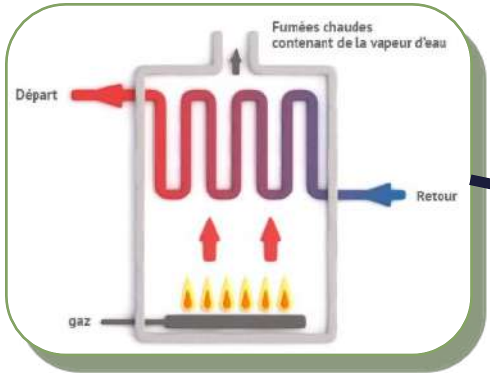
The production of a high quality effluent (permeate) is a significant advantage of the RO process. In particular the removal of non-degradable components of leachate such as chloride, or residual COD and heavy metals. However, all these contaminants are present within the concentrate, which can be 10%-25% of the leachate volume. In the majority of cases concentrate is returned to the landfill, in other instances the concentrate is disposed of off site. In addition, all chemicals required for effective operation of an RO plant are contained in the concentrate. This amounts to about 0.3% of each cubic meter of leachate treated. Chemicals including citric acid, membrane cleaner and anti-scaling detergents. Modern designed membrane modules do not require treatment with biocides.

Disposal of concentrate is a key factor to be addressed. To date, concentrates have widely been recirculated back into landfilled wastes. The sustainability of this practice would have to be assessed on a site by site basis. Some data indicates that the return of concentrate to the landfill coincides with an increase in concentration in the leachate of COD and NH4-N as well as an increase in conductivity. However, other data (Loeblich 2005 and Blumenthal 2005) shows that on some European sites there is no significant increase in diluted contaminants in landfill leachate following the commencement of concentrate return.

Source: IPPC S5.03, UK, Guidance for the treatment of landfill leachate, 2007

الطرق الحرارية لمعالجة سائل الرشيح
Thermal methods

Boiler



Heat

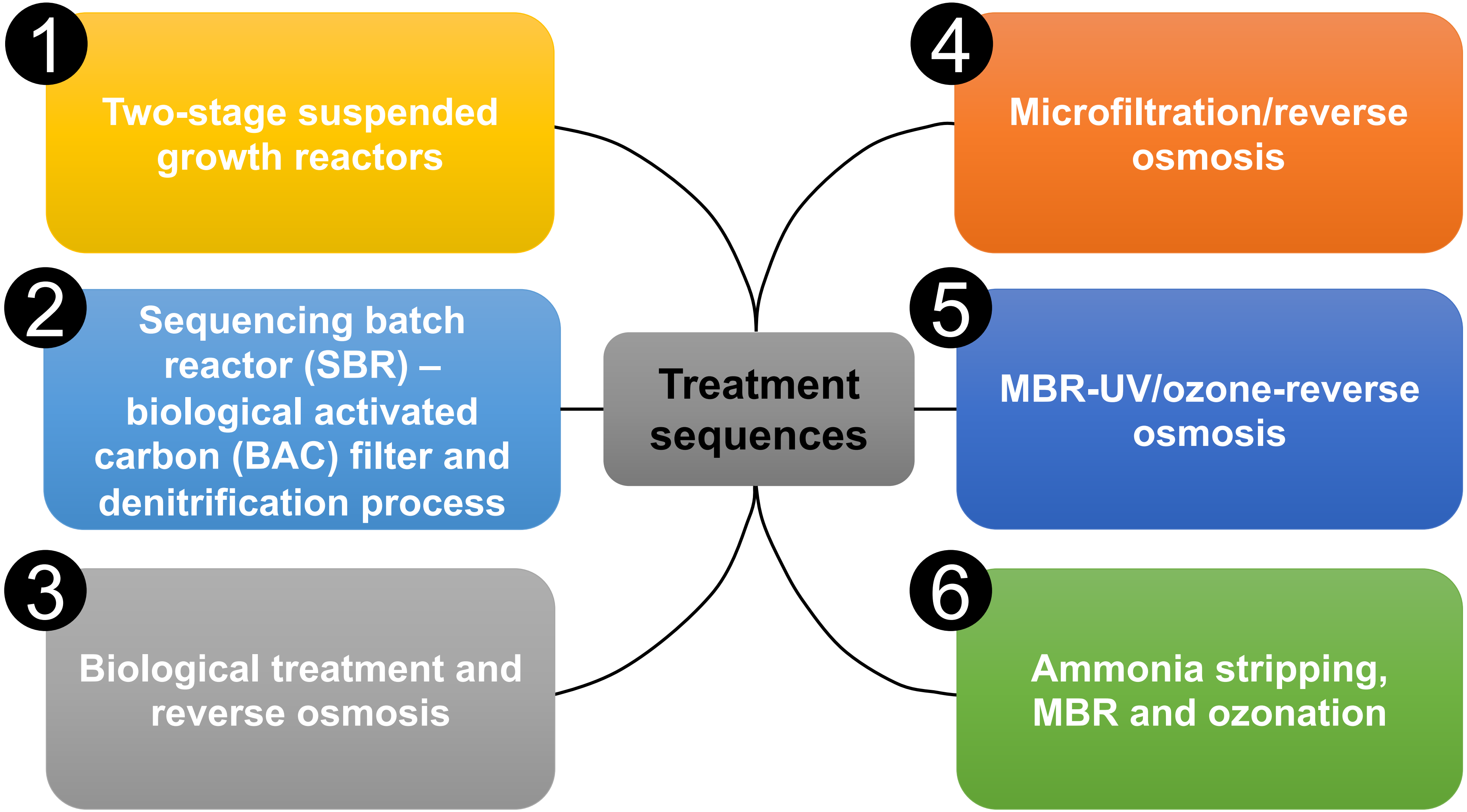
Biogas Engine

Treated Water

Concentrate
(Salts)

Electricity production

طرق المعالجة التسلسلية لسائل الرشيح
Sequential treatment methods

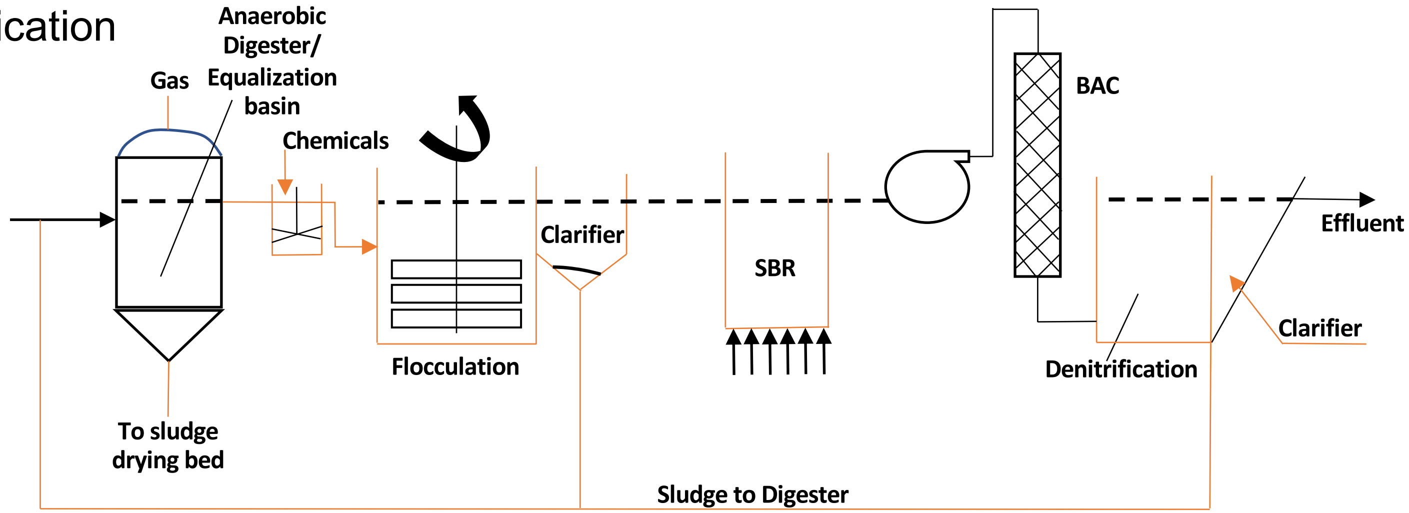


طرق المعالجة التسلسلية لسائل الرشيح
مثال ١
Sequential treatment methods

Sequencing batch reactor (SBR) - biological activated carbon (BAC) filter

- ✓ Treatment process with pre-treatment using an anaerobic reactor (equalization take place) followed by coagulation-flocculation (heavy metal precipitation occurs) and subsequently by SBR-BAC filter and denitrification process could be successful in treating young and middle aged leachate.
- ✓ The SBR would enrich the microbial population with desired metabolic capabilities, stability and settling characteristics in which both the biodegradable and refractory organics could be removed.
- ✓ The biological activated carbon would help in creating a biofilm to metabolize refractory organics and initiate nitrification of the residual ammonia. The nitrate nitrogen would be removed in the denitrification tank.

SBR-BAC and denitrification process for young to medium age landfill



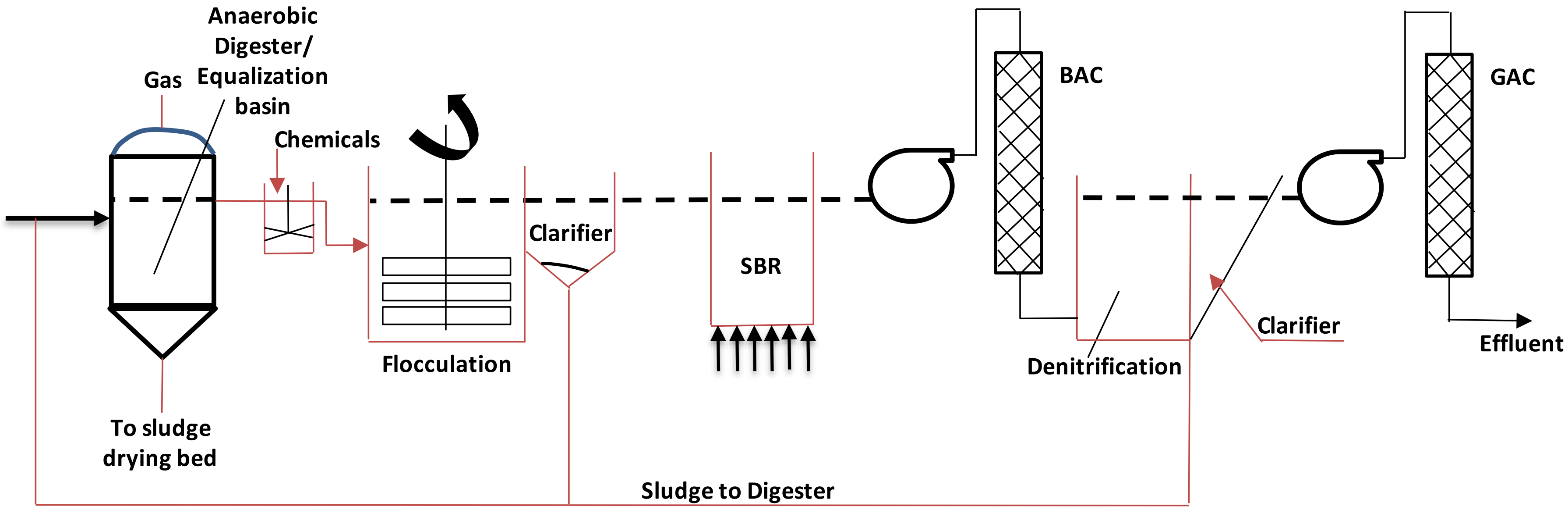
Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٢
Sequential treatment methods

Two-stage suspended growth reactors

- ✓ With an increase in the landfill age, the facility could be upgraded by the addition of granular activated carbon columns.

SBR-BAC and denitrification process for old landfill



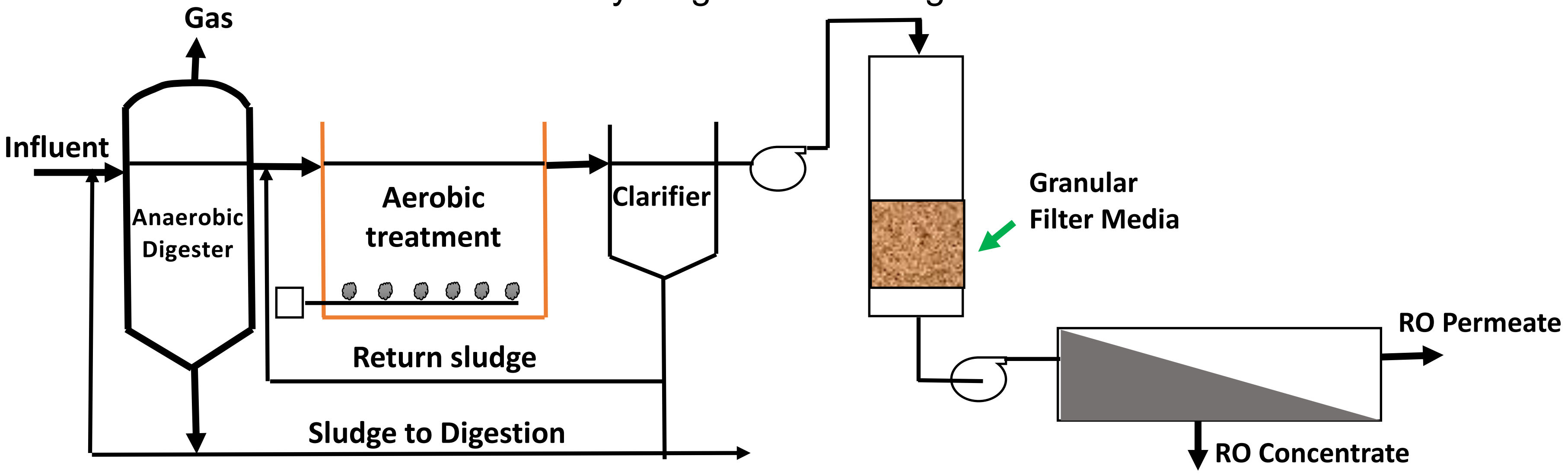
Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٣
Sequential treatment methods

Biological treatment and reverse osmosis

- ✓ A treatment sequence that is capable of removing mineralized material should include anaerobic digestion (stabilizes the waste), suspended growth biological waste treatment (degrades the biological matter), partial softening, filtration and reverse osmosis.
- ✓ The effluent is polished in a gravity filter and dematerialized in RO unit, thus achieving an effluent devoid of dissolved salts and low in organics.

Leachate treatment with biological treatment and reverse osmosis for young to medium age landfill



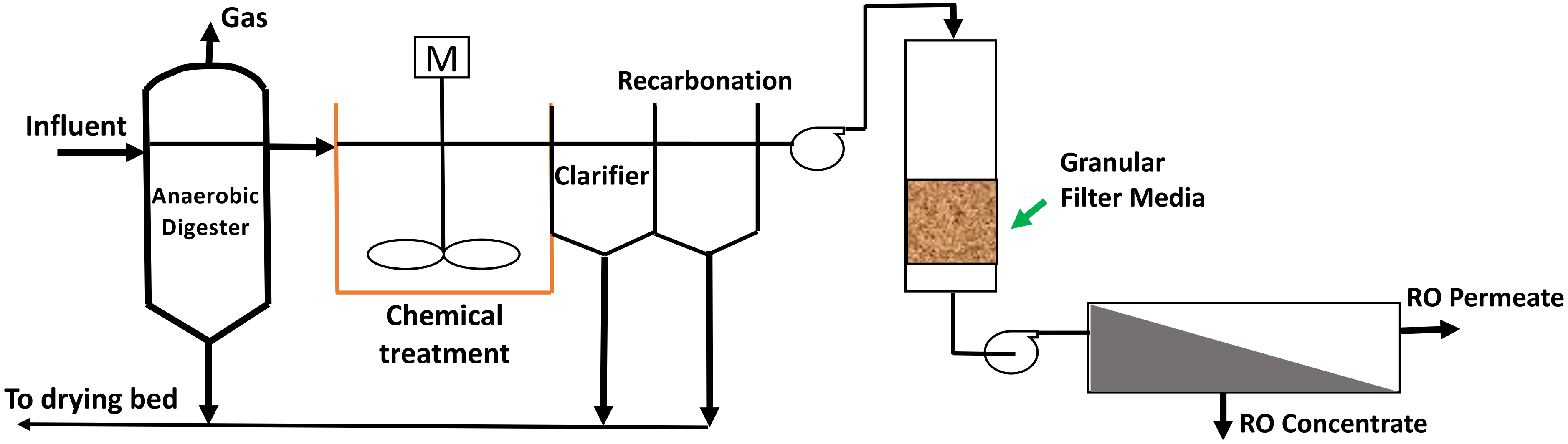
Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٤
Sequential treatment methods

Two-stage suspended growth reactors

- ✓ With increase in age, the biological treatment could be replaced by coagulation-precipitation process followed by re-carbonation, filtration and RO.

Leachate treatment with biological treatment and reverse osmosis for old landfill

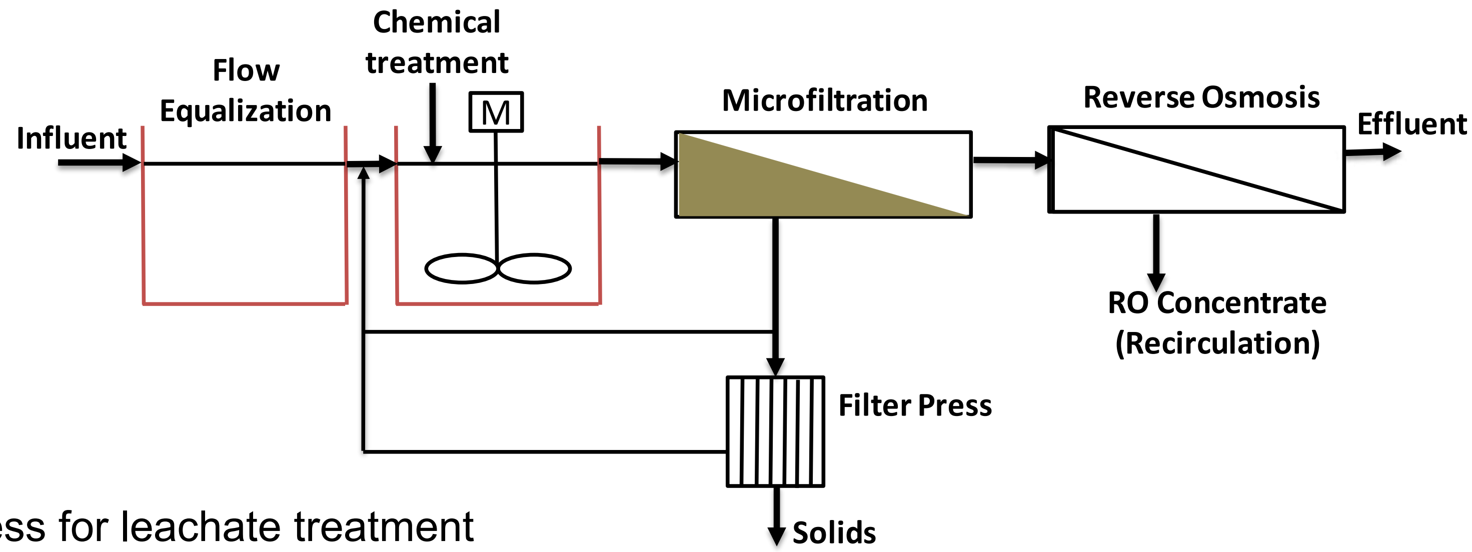


Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٥
Sequential treatment methods

Microfiltration/reverse osmosis

- ✓ The combination of microfiltration and reverse osmosis could also lead to a well-developed treatment sequence.
- ✓ The first step of precipitation and microfiltration provides a simple pre-treatment (removal of toxic metals and suspended solids) for the RO unit and thus produces a high quality effluent free of solids and dissolved organics.
- ✓ However, similar to other membrane processes, the system is susceptible to fouling, antifouling strategies needs to be evaluated.
- ✓ The process is suitable for leachates of all ages.



MF and RO process for leachate treatment

Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٦
Sequential treatment methods

MBR-UV/ozone-reverse osmosis

The basic technologies selected in the study were:

- ✓ Membrane bioreactor for biological treatment by aerobic oxidation and nitrification;
- ✓ UV/ozone for increasing biodegradability and for partial removal of organic residuals, as well as breaking down and partially oxidizing low degradable molecules; and
- ✓ Reverse osmosis treatment for the elimination of dissolved solids and reducing of organic load.

MBR-UV/ozone-RO process for leachate treatment

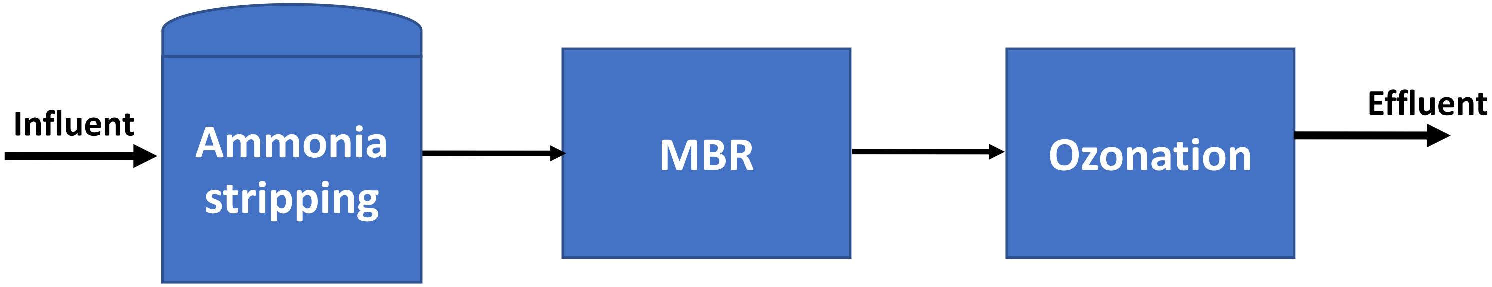
Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

طرق المعالجة التسلسلية لسائل الرشيح
مثال ٧
Sequential treatment methods

Ammonia stripping, MBR and ozonation

- ✓ Ammonia removal by air stripping can reduce ammonia concentration from 2,000 - 200 mg/L.
- ✓ Ammonia stripping as pre-treatment also has an advantage of reducing refractory compounds, thereby reducing the COD by precipitation when the pH is adjusted.
- ✓ If pre-treatment of ammonia stripping fails, shock loading will occur caused by ammonia in the biological system, making it difficult for the floc to settle down.
- ✓ Adoption of membrane system to replace the clarifier in the activated sludge process since membranes can retain total solids until the sludge recovers from the shock loading of ammonia.

Ammonia stripping, MBR and ozonation process for leachate treatment



Source: Asian Institute of Technology (2004). State of the Art Review Landfill Leachate Treatment, Thailand

3. Comparison among On-Site Leachate Treatment Options

مزايا وعيوب طرق المعالجة الفيزيائية/كيميائية
Physicochemical treatment methods

Physicochemical	Advantages	Disadvantages	Observations
Coagulation and Flocculation	Efficient in removal of humic acids, heavy metals, suspended solids and organic matter	The coagulants concentrations are required for the system operation are very high, turning it economically unfeasible to apply this technology in a real scale due to the costs of inputs and the management of chemical sludge generated	This technology appears as pre-treatment for some membrane systems
PACT (Powdered Activated Carbon Treatment)	Removes color, odor, taste, COD, chlorine, phenols, ammoniacal nitrogen and some toxins. Stabilizes and protects the process against shock loads of BOD and organic toxins. It has low installation costs, easy operation and maintenance. Technology appears as pre-treatment for some membrane systems	High operational costs with replacement of coal or on-site regeneration and outputs with high potential pollutants	Coal is added directly to the reactor for aeration, biological oxidation and physical adsorption occur simultaneously
Advanced Chemical Oxidation	It partially remove recalcitrant organic material and refractory compounds, dividing these molecules with high molecular weight, making them susceptible to microorganisms in biological reactors, increasing their biotratability	High process costs, such as energy, the value of inputs demanded in high doses and due to the complexity of the operation, requires a qualified technical operator	Among oxidative technologies, ozonization is the most widespread
Evaporation C	Leachate volume reduction up to 95%	Emission of polluted gases, high energy cost where approximately 60kg of gasoline is needed to burn $1m^3$ of leachate. A dry sludge output is generated in the order of 5% of the total volume	The most widely used option is the capture and burning of the biogas generated by the landfill itself

Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

مزايا وعيوب طرق المعالجة البيولوجية
Biological treatment methods

	System Type	Advantages	Disadvantages	Observations
Biological treatment under aerobic conditions	Air Stripping	90% removal of COD and ammoniacal nitrogen	It is not always that it shows good results due to the large periods of hydraulic detention and high costs (CAPEX / OPEX)	It is worth highlighting the difficulty of solubilizing the oxygen in the leachate, and it may be necessary to acquire a condensator to optimize the process. In addition, is advised the insertion of phosphoric acid (H3PO4) in a ratio of 1: 100 of the BOD concentration
Biological treatment under anaerobic conditions	Stirred tank Anaerobic filter UASB Movie bed Fixed bed	Simple techniques; low cost; reduced hydraulic holding times; low sludge generation; ability to receive high concentrations of organic components	Temperature factor, requiring heating or cooling. The toxicity of leachate, especially that of ammonia, may represent a danger to the microbiological fauna responsible for anaerobic degradation. Low efficiency	It is worth mentioning the possibility of using biogas, generated at the landfills as an energy source, to maintain the desirable temperature
Activated Sludge	Conventional System	Efficiency removal of BOD5 and COD between 90 and 99%; metal removal efficiency between 80 and 99%	High costs (CAPEX / OPEX); low efficiency in fecal coliform removal; sensitive to certain toxicities; disposal of the final sludge; possible environmental problems with aerosols and noise	This technology consists of three modules: an aerobic reactor, a sedimentation tank separating the liquid and solid material, and a recirculation system of the sludge generated in the settlers

Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

مزايا وعيوب طرق المعالجة باستخدام الأغشية

Membrane treatment methods

Attention

Membranes	Advantages	Disadvantages	Observations
Ultrafiltration	The organic matter can be removed with an efficiency of 50%	Does not have an efficient removal of COD	It is very used with Reverse Osmosis and Membrane Bioreactor systems, reaching a high level in the quality of leachate treatment
Nanofiltration	Efficiency in COD removal, 60-80%, 50% ammonia and control of organic, inorganic contaminants, approaching the efficiency of Reverse Osmosis	For leachates with high calcium concentrations, combined with high levels of organic matter, can cause excessive membranes fouling, increasing operational costs	It becomes a problem when chlorides removal is required by the current legislation, being an efficient hybrid treatment, especially with biological systems
Reverse Osmosis	Better efficiency in the removal of all pollutants, between 98 to 99%. Operational cost are competitive	Energy costs are the highest of membrane systems, about 5 kWh / m^3 due to high pressures	It has been successfully applied in the last 30 years throughout Europe
Membrane Bioreactor (MBR)	Removals that reach 99% in BOD and 70 to 96% of COD. Bacteria maintenance inside the reactor, higher concentration of biomass generated, compaction, operational flexibility, automated control of hydraulic detention time and sludge, removal of up to 95% of recalcitrant substances and attends high volumetric loads	Higher investment costs and operational complexity	The potential of using an MBR system upstream of a reverse osmosis unit for purification is interesting in reducing the frequency of downstream membrane fouling and producing a very high quality effluent with lower concentrate generation. Therefore, the technological combination recently pointed out as more efficient and effective

Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

مزايا وعيوب طرق المعالجة بالخلط في محطات الصرف الصحي
Co-treatment methods

CO-TRATAMENT	
Advantage	Disadvantages
1) Reduction of the COD / BOD ratio of leachate, increasing its biodegradability due to synergistic effect when it is mixed with sewage. In addition to the greater amount of organic matter available biologically, encouraging the degradation and stabilization of microorganisms 2) The dilution effect of the leachate, by reducing its concentrations after mixing with domestic sewage 3) Alkalinity, characteristic of leachates from landfills in the methanogenic phase, favors anaerobic treatments maintaining pH, eliminating the need for external means of correction 4) Operational simplicity for landfills, requiring only leachate transportation 5) The problem of leachate treatment is resolved relatively quickly without the need for large investments	1) Many STP's were not designed to receive a certain organic load which is a considerable increment with the addition of leachate in the affluent. It could affect negatively the efficiency and performance of the installation. 2) There may be an increase in recalcitrant substances in the treated effluent, conventional STP are not prepared to treat this type of substance 3) The metals deserve special attention due to inhibitory action towards the nitrifying and heterotrophic bacteria. It is a fact that the high level of Zinc in leachates from landfills in acidogenic phase 4) The high ammonia charges injected into the system are a threat to the STP. A form of ammonia with the highest pH, called ammonia, is highly toxic to fish. Another dangerous derivation comes from the partial oxidation, generating nitrite that has inhibiting effect to bacteria, compromising the station's efficiency 5) The presence of heavy metals makes it impossible to reuse sludge from STP 6) High costs and risks for leachate transportation to STP 7) The leachate concentration is a disturbance to conventional sewage treatment processes, it does not efficiently remove refractory organic compounds and bioaccumulative substances 8) STP's ability to assimilate an extra load of its affluent, as well as its compatibility of treatment processes and the possible increase in the production of sludge as well as the alteration of its composition preventing its reuse are also disadvantages

Source: Lippi et al, State of art landfill leachate treatment: literature review and critical evaluation, 2018

مقارنة بين بدائل معالجة سائل الرشيح وفق الخبرة العالمية (١)

العنصر	عمليات المعالجة الفيزيائية والكيميائية				المعالجة البيولوجية				
	التخثر والتلبد	الترسيب	الإمتصاص الكيميائي أو الإمتزاز	الأكسدة	الحمأة النشطة	مفاعلات الدُفعات التسلسلية	القرص الدورية البيولوجية	غشاء المفاعل الحيوي	مُفاعل التدفق العلوي اللاهوائي عبر طبقة الحمأة
النفقات الرأسمالية (CAPEX)	متوسط	منخفض	متوسط	متوسط	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
النفقات التشغيلية (OPEX)	مرتفع	منخفض	مرتفع	مرتفع	مرتفع	متوسط	متوسط	متوسط	متوسط
عمالة ماهرة	متوسط	منخفض	متوسط	متوسط	متوسط	مرتفع	منخفض	مرتفع	مرتفع
كفاءة المعالجة	متوسط	منخفض	متوسط	متوسط	مرتفع	متوسط	متوسط	متوسط	متوسط
سرعة المعالجة	مرتفع	منخفض	مرتفع	مرتفع	منخفض	متوسط	متوسط	متوسط	متوسط
متطلبات الأرض	متوسط	مرتفع	متوسط	متوسط	مرتفع	منخفض	منخفض	منخفض	منخفض
السلامة ضد حمولة الذروة	متوسط	مرتفع	متوسط	متوسط	متوسط	منخفض	منخفض	منخفض	منخفض

مقارنة بين بدائل معالجة سائل الرشيح وفق الخبرة العالمية (٢)

العنصر	المعالجة بالأغشية			المعالجة الحرارية	برك التبخير الطبيعية
	التناضح العكسي	الترشيح الفائق	الترشيح النانوي		
CAPEX	مرتفع	مرتفع	مرتفع	مرتفع	متوسط
OPEX	مرتفع	مرتفع	مرتفع	مرتفع	منخفض
عمالة ماهرة	مرتفع	مرتفع	مرتفع	مرتفع	منخفض
كفاءة المعالجة	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
سرعة المعالجة	مرتفع	مرتفع	مرتفع	مرتفع	منخفض
متطلبات الأرض	متوسط	متوسط	متوسط	متوسط	مرتفع
السلامة ضد حمولة الذروة	منخفض	منخفض	منخفض	منخفض	مرتفع

مقارنة بين بدائل معالجة سائل الرشيح وفق الخبرة العالمية (٣)

العنصر	العلاج التسلسلي					
	الترشيح الدقيق/التناضح العكسي	غشاء المفاعل الحيوي – الأشعة فوق البنفسجية/المعالجة بالأوزون – التناضح العكسي	تجريد الأمونيا – غشاء المفاعل الحيوي – المعالجة بالأوزون	مفاعلات نمو على معلقة مرحلتين	مفاعل الدُفعات التسلسلية – مرشح الكربون المنشط البيولوجي – عملية نزع النتروجين	العلاج البيولوجي والتناضح العكسي
CAPEX	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
OPEX	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
عمالة ماهرة	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
كفاءة المعالجة	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
سرعة المعالجة	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
متطلبات الأرض	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع	مرتفع
السلامة ضد حمولة الذروة	منخفض	منخفض	منخفض	منخفض	منخفض	منخفض

الانبعاثات المتوقعة في عمليات إدارة سائل الرشيح

هام جدا

الجدول يوضح نوعية الانبعاثات الأساسية ومصدر تولدها في المراحل التالية:

- استقبال سائل الرشيح
- نقل سائل الرشيح
- المعالجة الفيزيائية air stripping
- المعالجة الفيزيائية solid removal
- المعالجة الكيميائية chemical treatment
- المعالجة البيلوجية biological aerobic treatment
- المعالجة البيلوجية biological anaerobic treatment
- المعالجة الطبيعية engineered wetland
- نقل المخلفات الصلبة الناتجة من المعالجة removal of solid residues from vessels

Source: IPPC S5.03, UK, Guidance for the treatment of landfill leachate, 2007

Releases → / Source ↓	Substances: Ozone	NH_3-N	H_2S	H_2O_2	Odours	COD	VOC's	Methane	Metals	Suspended Solids
KEY	To air (A) To water (W) To land (L)									
Acceptance (sampling/ vehicle waiting)			A		A		A	A		
Transfer (pipework/ pumps/valves)		W	A		A	W	A	A/W	W/L	
Physical treatment Air stripping		W			A	W	A	A/W	W/L	W
Physical treatment Solid removal		W	A		A	W	A	A/W	W/L	W
Chemical treatment	A	W		W	A	W	A	A/W	W/L	W
Biological aerobic treatment		W			A	W	A	A/W	W/L	W
Biological anaerobic Treatment		W	A		A	W	A	A/W	W/L	W
Engineered wetlands		W	A		A	W	A	A/W	W/L	W
Removal of solid residue from vessels					A		A	A	W/L	W

4. On-Site versus Off-Site Leachate Treatment

أ-١

متطلبات إنشاء محطة لمعالجة سائل الرشيح في موقع المدفن الصحي

- أدني مستوي ممكن من الانبعاثات الغازية
- أدني مستوي ممكن من aerosols
- أدني مستوي ممكن من الضوضاء
- أدني مستوي ممكن من مساحة الأرض foot print
- أعلي مستوي ممكن من كفاءة التشغيل والصيانة zero down-time
- المياه المعالجة تصلح لنوعية الزراعة بالموقع
- المنظر الخارجي للمحطة يتناسق مع باقي استخدامات الأراضي بالموقع

Next slide

أ-٢

متطلبات إنشاء محطة لمعالجة سائل الرشيح بالنقل الي أقرب محطة صرف صحي

- مستوي الانبعاثات الغازية في حدود الاشتراطات البيئية
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- تدخل التكلفة الاستثمارية وتكلفة التشغيل والصيانة كعوامل مفاضلة بين البدائل

يتم مراعاة أعلي معايير الأمان في تصميم وطرح وترسية نظام نقل سائل الرشيح الي موقع المعالجة الخارجي

صورة ملهمة !!

London 2011 Olympic Park sewage pumping station !

أ-١

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↓

نظام المعالجة التسلسلية وتشمل وحدات الفصل بالأغشية

أ-٢

متطلبات إنشاء محطة لمعالجة سائل الرشيح بالنقل الي أقرب محطة صرف صحي

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↓

نظم برك التبخير

أ-١

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التعاقد بنظام DBO

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التعاقد بنظام DB or DBB

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عقد واحد ويشمل صيانة شبكة تجميع الرشيح ومحطة المعالجة

أ-٢

متطلبات إنشاء محطة لمعالجة سائل الرشيح بالنقل الي أقرب محطة صرف صحي

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عقدين: (١) عقد نقل سائل الرشيح، (٢) عقد محطة المعالجة

5. Leachate Accumulated Inside the Cells

Leachate accumulated inside the cells

- In a typical design and operation of modern landfills, a Leachate Collection and Recovery System is in place. The system will operate effectively to keep the leachate level inside the cell at 30 above the upper surface of the base liner.
- Bioractor landfills are exception because it is designed to recirculate leachate back to landfill cells

Leachate Extraction and Level Control System (LELCS)

The leachate extraction and level-control system should:

1. Include a collection sump and leachate riser(s) to facilitate extraction of leachate from the cell. The riser should be stable under the load of the surrounding waste mass and should be able to withstand stresses due to settling of the surrounding waste. The pipes should comply with the requirements of applicable standards for the pipe material, for example Precast concrete pipes (pressure and non-pressure) .
2. Be installed in all cells, be able to control leachate levels within each cell, and be able to convey collected leachate out of the cell to surface storage or other infrastructure
3. Be able to keep the leachate level no greater than 300 mm above the upper surface of the base liner, or below some other level that is justified by the design, site conditions and leachate management measures (Note: The flow of leachate through the liner is greater when leachate is allowed to accumulate within the cell. Higher leachate levels can also interfere with landfill gas controls.)
4. Be able to continue to function effectively until the landfill is considered stable

طرق سحب سائل الرشيح المتراكم داخل خلايا المدفن الصحي – الخبرة العالمية
نوع طلمبات السحب: Pneumatic pumps

Designed to pump leachate & contaminated groundwater

Over 90% of sites in the UK use pneumatic pumps.

Most pneumatic pumps are safe to use in potentially explosive environments.

Provided they are regularly serviced, most pneumatic pumps have a 10 year + life-expectancy.

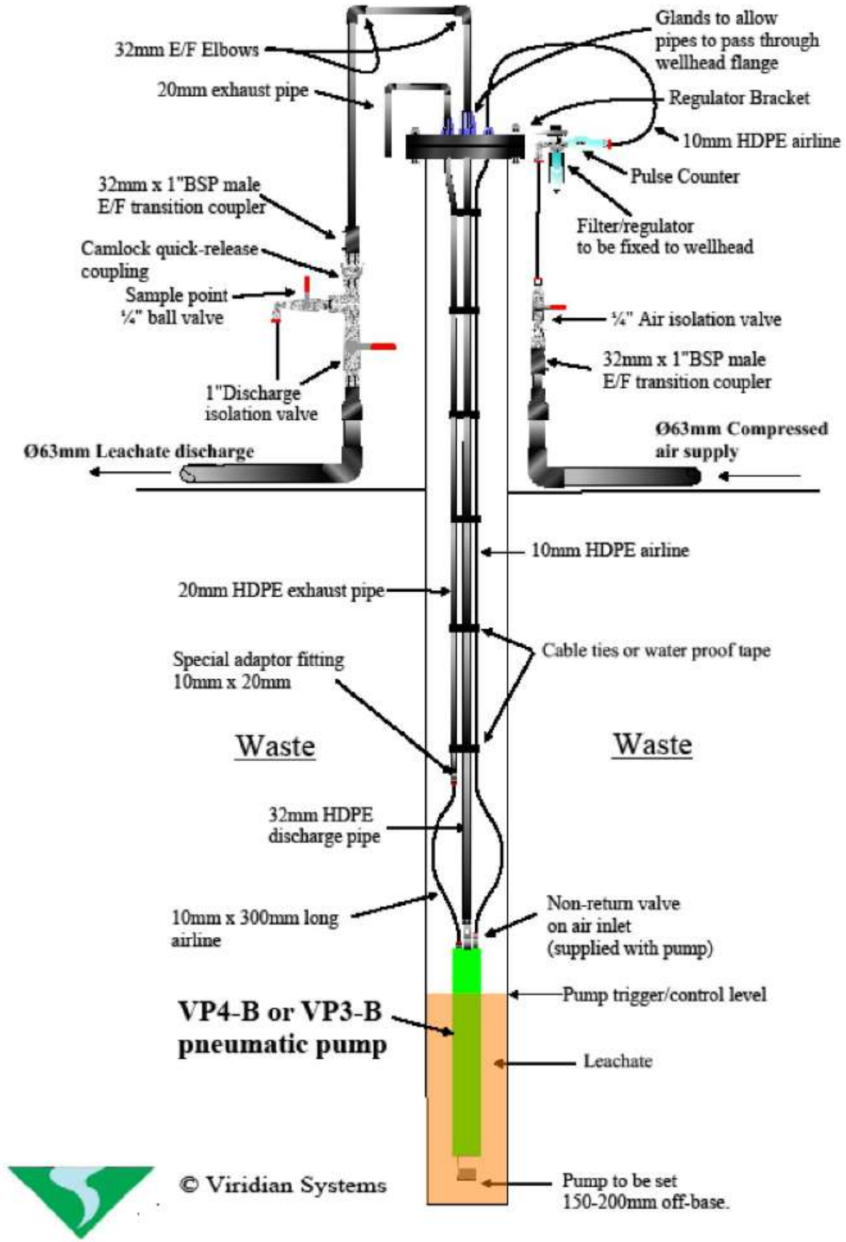
Typical leachate pumping well with pneumatic pump installed on a UK landfill

Most UK landfills have multi-well pump installations. Some sites have as many as 120 pumps installed.

Typical UK hydrostatic compliance head = 1m above basal liner system.

طرق سحب سائل الرشيح المتراكم داخل خلايا المدفن الصحي – الخبرة العالمية

نوع طلمبات السحب: Pneumatic pumps



قطاع في بئر السحب باستخدام
Pneumatic pumps

6. Monitoring Requirements

Model leachate monitoring program (Australian EPA)

Pollutant	Units of measure	Frequency	Sampling method
Electrical conductivity	μS/cm	Quarterly	Probe
pH	pH units	Quarterly	Probe
Standing water level in all leachate risers	m AHD	Quarterly	In situ and when not depressed by leachate extraction
Volume	m^3	Continuous	From flow meters or pumping records of the amount of leachate transferred from cell
Total dissolved solids	mg/L	Annually	Grab sample
Total suspended solids	mg/L	Annually	Grab sample
Major cations and anions (calcium, magnesium, potassium, sodium, chloride, fluoride and sulfate)	mg/L	Annually	Grab sample
Alkalinity (bicarbonate and carbonate)	mg/L	Annually	Grab sample
Dissolved organic matter (total organic carbon, biochemical oxygen demand, chemical oxygen demand)	mg/L	Annually	Grab sample
Ammonia and nutrients (nitrate, nitrite, and phosphorus)	mg/L	Annually	Grab sample
Metals (aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, zinc)	mg/L	Annually	Grab sample
Organic contaminants: • phenols • petroleum hydrocarbons • monoaromatic hydrocarbons (in particular benzene, toluene, ethylbenzene and xylene) • organochlorine and organophosphate pesticides • polycyclic aromatic hydrocarbons.	mg/L	Annually	Grab sample

Note: AHD = Australian Height Datum.

Model groundwater monitoring program (Australian EPA)

Pollutant	Unit of measure	Frequency	Sampling method
pH, redox potential and temperature		Quarterly	Probe, field analysis
Standing water level	m AHD	Quarterly	In situ
Total dissolved solids	mg/L	Quarterly	Grab sample
Major cations and anions (calcium, magnesium, potassium, sodium, chloride, fluoride and sulfate)	mg/L	Quarterly	Grab sample
Alkalinity (bicarbonate and carbonate)	mg/L	Quarterly	Grab sample
Total organic carbon	mg/L	Quarterly	Grab sample
Ammonia and nutrients (nitrate, nitrite, and phosphorus)	mg/L	Quarterly	Grab sample
Metals (aluminium, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, zinc)	mg/L	Annually	Grab sample
Organic contaminants: • phenols • petroleum hydrocarbons • monoaromatic hydrocarbons (in particular benzene, toluene, ethylbenzene and xylene) • organochlorine and organophosphate pesticides • polycyclic aromatic hydrocarbons.	mg/L	Annually	Grab sample

Note: AHD = Australian Height Datum.

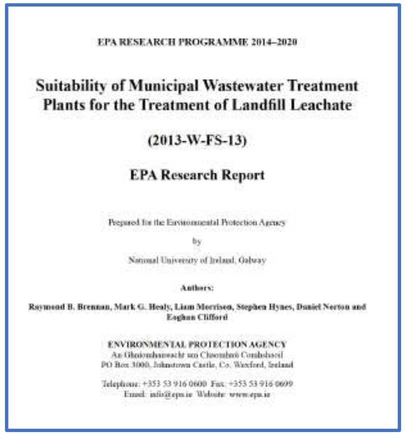
٧. عينة من المراجع ذات الصلة

BID DOCUMENTS
FOR

Supply, Construction, Erection, Testing and Commissioning for 300 KLD Treatment Plant for Leachates generated from Dhapa Closed Dumpsite in Kolkata, West Bengal

MAY - 2016

West Bengal Pollution Control Board (WBPCB)
World Bank Assisted Project
West Bengal Pollution Control Board, Parivesh Bhavan, 10 "A", Block - LA, Sector III, Bidhan Nagar, Kolkata - 700098.



EPA RESEARCH PROGRAMME 2014–2020

Suitability of Municipal Wastewater Treatment Plants for the Treatment of Landfill Leachate

(2013-W-FS-13)

EPA Research Report

Prepared for the Environmental Protection Agency
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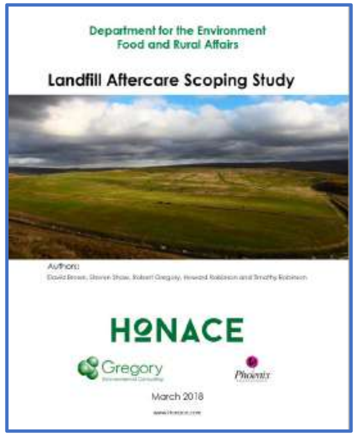

Department for the Environment
Food and Rural Affairs

Landfill Aftercare Scoping Study

Authors:

HONACE

Gregory

Phoenix

March 2018

Artigo Original

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State of Art of Landfill Leachate Treatment: Literature Review and Critical Evaluation

O Estado da Arte do Tratamento do Lixiviado de Aterros Sanitários: Revisão Bibliográfica e Avaliação Crítica

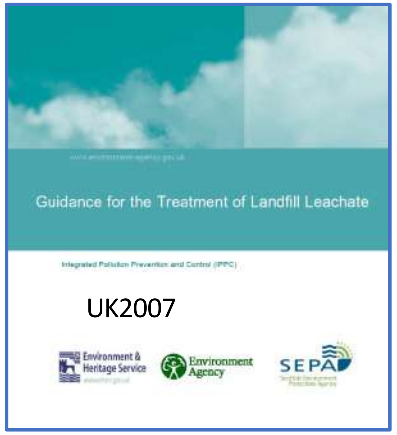
Marcelo Lippi[1], Michelle Bellas Romariz Gaudie Ley[2], Gabriel Pinna Mendez[3] e Ricardo Abranches Felix Cardoso Junior[4]

[1,2,4]Universidade Federal Fluminense, RJ, Brasil
[3]Centro Federal de Educação Tecnológica Celso Suckow da Fonseca , RJ, Brasil

Abstract

Population growth, especially in urban areas, combined with modern levels of social consumption, contribute for a significant increase of waste production. Among the environmental impacts resulting from the operation of landfills, the generation of leachate is certainly one of the most significant and most difficult to control. The composition of leachate is complex and varied; it contains physicochemical and biological characteristics that are aggressive to the soil, water resources, fauna and flora. The technical and operational difficulties to handle it are challenges for waste managers. There are several methods to treat leachate, which are widely debated in the literature, each having advantages and disadvantages. The present paper has the objective of carrying out a bibliographical review of leachate treatment from landfills, addressing the main technologies, as well as discussing their applications, advantages, disadvantages and uncertainties. According to what was studied, the technologies that have been found to have the best practical results and, in general, reach the parameters for treated effluent provided for environmental legislations, are those that use filtering membranes. However, one of the major disadvantages of these processes is the generation of a concentrate, which is normally recirculated in the landfill itself.

Keywords: *Leachate treatment; Landfills; Solid waste management*



Guidance for the Treatment of Landfill Leachate

Integrated Pollution Prevention and Control (IPPC)

UK2007

Environment & Heritage Service

Environment Agency

SEPA

مراجع

مراجع

Waste Management

Co-Treatment of Landfill Leachate

Technical Memorandum No. 1: Existing Conditions and Opportunity Statement (Draft)

Prepared by:
AECOM
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Kitchener, ON, Canada N2P 0A4 519.650.3424 fax
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Project Number:
60272630

Date:
December 2012

Influence of landfill leachate on municipal wastewater treatment - model plant (WWTP-MP)

B. Quant, S. Fudala-Książek, A. Łuczkiewicz, E. Kulbat, K. Jankowska, K. Czerwionka, K. Olańczuk-Neyman

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377 © IWA Publishing 2016 Water Quality Research Journal of Canada | 51.4 | 2016

Co-treatment of old landfill leachate and municipal wastewater in sequencing batch reactor (SBR): effect of landfill leachate concentration

Kshitij Ranjan, Shubhrasekhar Chakraborty, Mohini Verma, Jawed Iqbal and R. Naresh Kumar

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Journal of Environmental Management 188 (2017) 64–72

Contents lists available at ScienceDirect

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ELSEVIER

Research article

Treatment of landfill leachate in municipal wastewater treatment plants and impacts on effluent ammonium concentrations

R.B. Brennan [a, b, *], E. Clifford [a, b], C. Devroedt [a, c], L. Morrison [b, d], M.G. Healy [a, b]

[a] Civil Engineering, National University of Ireland, Galway, Ireland
[b] Ryan Institute, National University of Ireland, Galway, Ireland
[c] Institut National des Sciences Appliquées de Lyon, Lyon, France
[d] Earth and Ocean Sciences, School of Natural Sciences, National University of Ireland, Galway, Ireland

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Journal of Environmental Management 141 (2014) 9–15

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/jenvman

ELSEVIER

Co-treatment of landfill leachate and domestic wastewater using a submerged aerobic biofilter

F.M. Ferraz [a, *], J. Povinelli [a], E. Pozzi [a], E.M. Vieira [b], J.C. Trofino [a]

[a] Departamento de Hidráulica e Saneamento, Escola de Engenharia de São Carlos, Universidade de São Paulo, Av. Trabalhador Sao Carlense, 400, CEP 13566-590 Sao Carlos, São Paulo, Brazil
[b] Instituto de Química de São Carlos, Universidade de São Paulo, Av. Trabalhador Sao Carlense, 400, CEP 13566-590 Sao Carlos, Sao Paulo, Brazil

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