John F Hunt
REGENERATION

Guide to Trade Effluent Discharges

+44(0)1375 366 700
info@johnfhuntregeneration.co.uk
johnfhuntregeneration.co.uk

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How Important is Your Effluent Treatment Plant?

A production or manufacturing company will often, mistakenly, prioritise the production and manufacturing aspects of their business; less regard is paid to the treatment (processing) of their effluent (liquid waste).

Yet the limiting factor in the ability of a company to increase production, further reduce costs or even to bring new product lines to the market may be the capability of the company to manage its trade effluent. The effluent plant then becomes a bottle neck to increasing production. Frequently investment within a company's effluent treatment system lags behind investment in other parts of the business and only becomes an issue when there is a threat to the company' production capability.

An efficiently run business will take a holistic approach to its operations taking into account all of its inputs and outputs. Where possible a company should look to reduce both their inputs of raw materials including energy, and water then look to minimize the amount of waste including effluent that they generate, where possible recycling (re-use) of waste products should be undertaken.

Understanding Trade Effluent

Trade effluent is a liquid waste that is generated by the business activities that are been conducted at the premises.

Typical Trade Effluent is discharged into the foul sewer, pre-treatment of the effluent to make it suitable (safe) to discharge into a sewer may be required.

On occasions where discharge of the effluent into a foul sewer is not possible, the effluent may with the permission of the Environmental Regulator (EA, NRW, SEPA), discharge the effluent directly to water course in accordance with an Environmental Permit. Where discharge into a water course is undertaken a much higher standard of treatment would be required.

Only a small proportion of the trade effluent which is generated is discharged via this route, the majority is discharged to foul sewer in accordance with a Trade Effluent Consent.

What is Trade Effluent Made of?

Trade effluent is the liquid waste produced by business; therefore the overall composition of the effluent will reflect the nature of business activities undertaken within the premises.

However, all Trade Effluents have broadly speaking a similar composition (See Figure 1).

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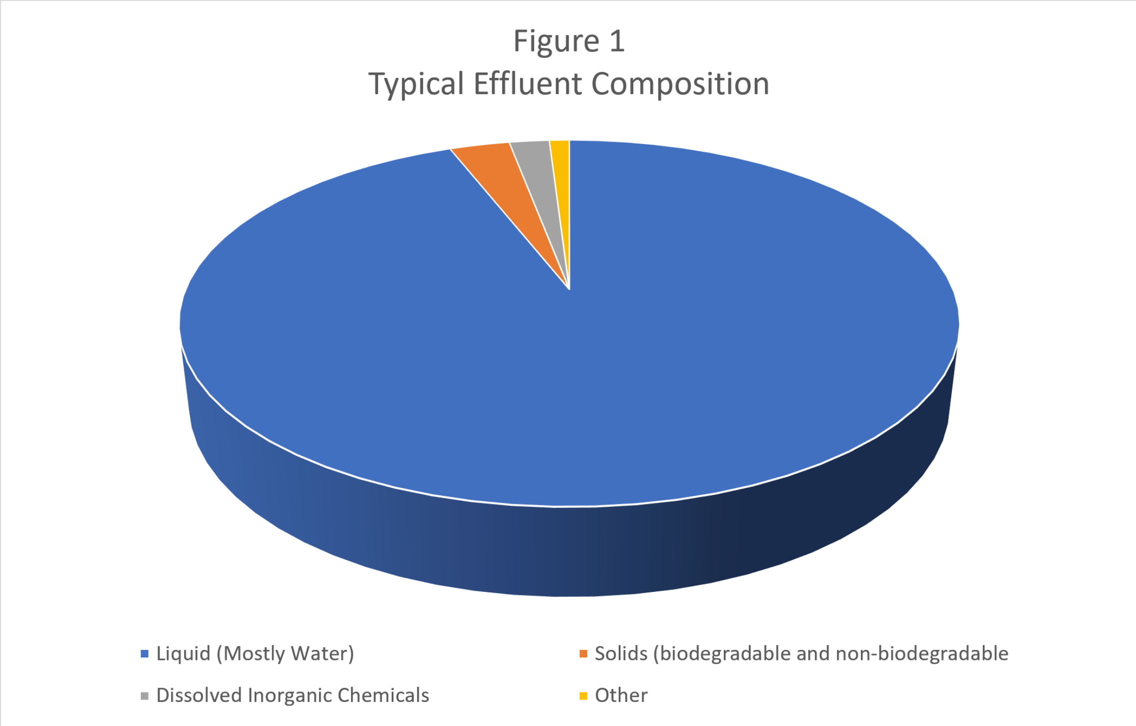

The majority of Trade Effluents can be characterised by having the following composition.

A liquid phase: The majority of the effluent will comprise a liquid phase. The liquid phase will predominantly have been generated through the addition of potable water, either associated with the production process or via the cleaning/washing down of plant and equipment. The sites potable water supply will be metered and the typically the water present within the discharge will have been purchased.

Suspended Solids: Suspended particles may be present within the effluent. These may, depending on the process being undertaken, be either of an organic biodegradable nature eg food by-products or may be of a non-degradable nature, eg microplastics, silt or sand. The Sewage Undertaker will place strict limits on the concentration of suspended particles present within the effluent as there presence may cause his infrastructure to become blocked and/or they may be difficult for his sewage treatment works to treat.

Dissolved In-organic Chemicals: Effluent may contain a variety of dissolved inorganic components eg Calcium, Sulphate, cyanide, Zootoxic Metals eg lead, and/or phytotoxic metals eg Copper. These components may chemically attack the sewer eg sulphate attach, be toxic in respect of the microbes used within the sewage treatment works eg cyanide, or may even concentrate within the sludge produced at the sewage treatment works, making it unsuitable for re-use eg heavy metals.

Other: Depending on the nature of the process producing the effluent a range of other compounds may be present. Often whilst these compounds are present in small concentrations, they may be highly toxic or resilient to treatment at the sewage treatment works. The allowable (permitted) concentration within the effluent will be very small.

The Sewage Undertaker, will regulate the allowable composition of the effluent that is discharged into the sewer. Pre-treatment of the effluent to bring it in line with the conditions stipulated within the Trade Effluent Consent may be required.

Trade Effluent Consent Conditions

As part of regulating the quality of the effluent which may be discharged into the foul sewer, limiting values for a range of parameters will be set. Commonly these will include limits on:

- Flow Rate
- Total Daily Volume
- Time of Discharge
- Temperature
- pH
- Toxic Metals
- Suspended Solids
- Sampling and Monitoring
- Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite.

Flow Rate: Limits on the flow rate that can be discharged into the foul sewer are required to ensure that the sewer system is not overwhelmed. Many foul sewers under specific storm conditions may discharge untreated sewage to discharge into rivers. Due to the high dilution rates associated with the storm conditions, this approach is considered acceptable. The flow rate limits imposed on the flows that may be discharged into a sewer are put in place to ensure that during non-storm conditions when the receiving water body may due to low flow conditions have only limited ability to dilute the sewage that the sewer is not overwhelmed and does not divert sewage into the river at a time when the river may have an insufficient level of flow to allow the dilution of the sewage to an acceptable level.

Rapidly Settling Solids: The concentration of solids present (mg/l) who settling velocity (m/hr) is greater than 2 m/hr.

Poorly Settling Solids: The concentration of solids present (mg/l) whose settling velocity is < 1 m/hr.

Total Suspended Solids (TSS): The total concentration (mg/l) of solids present.

Total Daily Volume: The sewage treatment works has the capability to treat a maximum amount of effluent. A limit on the total daily volume of effluent that may be discharged into the sewer is set to ensure that the sewage works has enough treatment capacity available to treat the effluent which it receives.

Suspended Solids: Tight limits on the concentration of suspended solids which may be discharged into the sewer are set. These limits are designed to minimise the presence of large concentration of suspended particles which may settle out within the sewer itself (rapidly settling solids) causing blockages and to limit the concentration of solids which may arrive at the sewage treatment works (poorly settling solids), a proportion of these solids may not be amenable to biological treatment and will therefore increase the volume of sludge which will be generated, increase the operating costs for the sewage treatment works.

Sampling and Monitoring: As a means of demonstrating compliance with the conditions of the Trade Effluent Consent, the need to monitor the flow rate and daily volume and the analysis of spot samples of the effluent to confirm its composition will be defined. Sampling may be undertaken by the operator with periodic independent sampling and monitoring by the sewage undertaker. This independent monitoring provides a means of determining the accuracy of the information provided by the operator. In addition to confirming compliance with the discharge conditions the information obtained will also be used to calculate the costs (financial charges) associated with the discharge.

Example Trade Effluent Consent Conditions

1. The temperature of the trade effluent shall not exceed 43 degrees C
2. The pH of the trade effluent shall not be less than 6 nor greater than 10
3. The total Suspended Solids in the trade effluent shall not exceed 600 mg/l
4. The total Ammoniacal Nitrogen in the trade effluent shall not exceed 200 mg/l
5. The total Phosphorous in the trade effluent shall not exceed 25 mg/l expressed as Phosphorous (P)
6. The Chemical Oxygen Demand from acidified dichromate (C.O.D) of the trade effluent shall not exceed 400 mg/l expressed as O
7. The highest rate at which the trade effluent may be discharged shall not exceed 15 litres per second (54 m3/hr)
8. The maximum volume of trade effluent to be discharged in any continuous period of 24hrs shall not exceed 1296 cubic meters
9. The total Iron in the trade effluent shall not exceed 10 mg/l
10. The total Aluminium in the trade effluent shall not exceed 0.5 mg/l
11. The total Chromium in the trade effluent shall not exceed 0.01 mg/l
12. The total Copper in the trade effluent shall not exceed 0.01 mg/l
13. The total Lead in the trade effluent shall not exceed 0.01 mg/l
14. The total Nickel in the trade effluent shall not exceed 0.01 mg/l
15. The total Zinc in the trade effluent shall not exceed 0.1 mg/l
16. The total Thiourea in the trade effluent shall not exceed 0.05 mg/l
17. The total Monohydric Phenols in the trade effluent shall not exceed 0.1 mg/l expressed as Phenol (C6H5OH)
18. The total Sulphides in the trade effluent shall not exceed 0.01 mg per litre expressed as S
19. The total Arsenic in the trade effluent shall not exceed 0.01 mg/l expressed as As
20. The total concentration of cyanide in the trade effluent, excluding ferrocyanide and ferricyanide, shall not exceed 0.05 mg/l as CN
21. The total Sulphates in the trade effluent shall not exceed 200 mg/l as SO4
22. The amount of Soluble Methane in the trade effluent shall not exceed 0.14 mg/l as CH4
23. The trade effluent shall not contain any substance or substances which either alone , or in combination with any other matter in the sewer or at the sewage treatment works which would give rise to obnoxious, poisonous or flammable gases, or create a statutory nuisance or would be harmful to the sewer network, the treatment process or the disposal of effluents or sludge generated at the works

A shaken sample is to be used except for COD, where the sample shall be the supernatant after 1 hrs of settlement.

Calculating Effluent Charges

Under Section 142 of the Water Industry Act 1991, the sewage undertaker is allowed to make a charge for the discharge of effluent into his sewer.
The calculation charge is calculated using the Modgen Formula.
In a simplified form the Modgen Formula can be expressed as:

Cost = Volume x Strength

- The more concentrated (stronger) the effluent the higher the charge.
- Even dilute effluents will be subjected to a charge eg clean water
- Dilution will not reduce the total cost payable.

A reduction in the overall cost of disposal will only be achieved by reducing the strength of the effluent and/or reducing the volume of effluent that is disposed.

Modgen Formula

$$C = R + V + \frac{Ot}{OS} x\, B + \frac{St}{Ss} x\, S$$

C = total charge per cubic meter of trade effluent

R= One third of the amount determined by the Sewage Undertaker as the average cost to the Sewage Undertaker for the year of charge of receiving into its sewers and conveying one cubic meter of sewage to the sewage treatment works

V=The amount determined by the sewage undertaker as the average cost for the year of charge of primary treatment and other volumetric treatment costs in the treatment of one cubic meter of sewage at the treatment works

Ot =The Chemical Oxygen Demand (COD) of the trade effluent in mg/l after one hour quiescent settlement

Os=The estimated average Chemical

Oxygen Demand (COD) of settled sewage in mg/l at the sewage treatment works as determined by the Sewerage Undertaker for the purposes of the year of charge.

B= The amount determined by the sewerage undertaker as the average cost to the sewerage undertaker for the year of charge of biological treatment of one cubic metre of sewage at the sewage treatment works.

St= The total suspend solids in the trade effluent in mg/l at the pH of the trade effluent.

Ss=The estimated average amount of suspended solids in mg/l determined on a shaken sample, in sewage received for treatment as the sewage treatment works as determined by the sewerage Undertaker for the purposes of the year of charge

S= The amount determined by the Sewerage Undertaker as the average cost to the Sewerage Undertaker for the year of charge, of primary sludge treatment and disposal of one cubic meter of sewage at the sewage treatment works

Drivers for Investing in Effluent Treatment

There are five main reasons why a company should consider investing it's the plants effluent treatment system. These are:

Achieving Compliance: Failure to ensure that the quality of the effluent achieves the conditions set out within the Trade Effluent Consent may result in Court action and subsequent fines. Where severe non-compliance or prolonged non-compliance issues occur; the Sewerage Undertaker has the ability to prevent further discharges into his sewerage system occurring.

Increased Capacity: Plans for increasing the factories production capacity may increase the volume of effluent that is produced. Increasing the capacity of the sites effluent treatment plant may give rise to a need to upgrade or modify the factories the existing effluent treatment plant.

Reducing Operating Costs: Modernisation of the effluent treatment plant may reduce electricity usage, reduce consumables, and or reduce the amount of waste generated. These benefits may reduce the cost of treating the effluent, reducing the facilities operating costs. In addition, the improvements may also reduce the amount of waste generated, again reducing the facilities operating costs.

Changes In Effluent Quality: Both the volume and composition of the effluent generated by the facility is a function of the operating processes undertaken at the facility. Where changes to the sites production is made, this may change the composition of the effluent that is delivered into the sites effluent treatment plant. Any changes in the nature of the effluent which is produced may necessitate a need to alter the sites existing effluent treatment capabilities.

More Stringent Discharge Targets. There is a continuing drive to reduce the amount of pollution that enters our inland waterways. Sewage undertakers are being put under increasing pressure to reduce the concentration of pollutants present within the discharge from the sewage treatment works. This in turn sees the undertaker imposing tighter limits on the quality of the effluent that is discharged into his network; making a need to upgrade the sites effluent treatment plant.

Options for Cost Reduction

Modifications/upgrades to a site's existing effluent treatment plant increases the opportunity to reduce costs though a number of routes, such as:

- Decreased operator intervention via increased levels of automation.
- Reduced effluent treatment costs.
- Reduced waste disposal costs.
- Reduced water consumption through increased rates of water recycling.
- Reduced trade effluent charges.
- Reduced waste disposal costs.
- Reduced maintenance costs.

There is a potential that the financial savings made will pay back the capital investment within a short period of time; increasing the overall profitability of the business.

Planning for Changes to the Operating Process

Where there is a planned change in the nature of the process to be undertaken at a facility the impacts which the change may have on the ability of the sites effluent treatment plant to cope with the change, ensuring that the site remains compliant needs to be assessed with modifications/upgrades built into the program for completing the planned operational changes. Key points which need to be addressed early on in the planning process are:

- What effect will the planned change have on both the peak flow rate needed to be handled by the effluent treatment plant and the total volume of effluent that will need to be altered.
- Will the composition of the effluent change, that is will new pollutants be introduced that need to be treated and/or will the strength (concentration) of the effluent become changed.
- Does the existing trade effluent consent need to be amended and will the sewage undertaker use this opportunity to impose, new or amended stricter conditions on the quality of the effluent that can be discharged.
- Will the existing plant be able to operate and ensure that the treated effluent discharged into the sewer remains compliant with the discharge conditions.

The development of a new production capability and the assessment of the requirements to treat the effluent need to be made concurrently.

Ten Steps to Becoming Water Efficient

Step 1 Engage all staff and senior management in your water saving programme.

Step 2 Identify how much your business is paying in water and wastewater charges and also what hidden charges your business is facing.

Step 3 Develop a water balance for your business attempting to quantify >90% of water use.

Step 4 Use the information in your water balance to design a Monitoring & Targeting (M&T) system.

Step 5 Use your water balance and M&T system to identify improvement actions to eliminate or reduce water use and minimise effluent generation (strength and volume).

Step 6 Identify water saving techniques that will allow these water saving opportunities to be realised.

Step 7 Prepare a Water Efficiency Action Plan (WEAP) to summarise and prioritise improvement actions including a business case for each action then implement them as appropriate. Regularly update your WEAP as new improvement actions are identified.

Step 8 Review and evaluate the actual improvement action benefits achieved.

Step 9 Communicate success to staff, senior management and your supply chain to maintain their engagement.

Step 10 Continually improve by returning to step 2

Increasing Production Capacity

Increasing the production capacity of a facility often increases both the instantaneous rate and/or the volume of effluent which may be generated. These increases may exceed the treatment capacity of the existing treatment works creating a need to increase the capabilities of the existing treatment plant.

Prior to committing to capital works program to increase the size of the sites existing effluent treatment capability it is prudent to understand:

1. Can the existing plant be optimised so enabling a greater amount of effluent to be treated by the existing effluent treatment works;
2. Is the capacity of the existing effluent treatment plant to treat the effluent limited by the peak or average effluent flow rate. Where the plant is limited by the peak flow rate conditions, can temporary effluent storage be put in place, reducing the peak flow to a level that the plant can cope with;
3. What can be done to limit the amount of effluent that is discharged into the sites foul drainage network. For example, can a program of water use reduction be implemented that will reduce the overall volume of effluent that needs to be treated. If so what effect will these efficiency measures have on both the volume of effluent and its composition have. Will reducing the volume of the effluent have the effect of increasing the strength of the effluent? This may have the unexpected effect of making the effluent more difficult to treat.

Prior to committing to capital expenditure it is important to understand what it is that is limiting the capacity of the existing effluent treatment plant. The capital improvement works need to correctly focus on the needs of the site, and cost effectively provide the needed increase in treatment capacity.

Treatment Solutions

Effluent Treatment is commonly categorised according to the following stages:

Preliminary Treatment: Initial recovery of large solids by screening. Various types of static and mechanical screens may be used. Preliminary treatment can also include the operation of "balancing tanks" used to even out the flow and strength of the effluent prior to subsequent treatment.

Primary Treatment: This stage is characterised by the removal of gross levels of suspended particles and/or the oil and grease. Commonly involve the use of pH adjustment unit, oil water separators, settlement units (clarifiers), or dissolved floatation units (DAF).

Secondary Treatment: Frequently biological treatment using microbes to remove organic materials which have not been removed by the previous treatment stages. Treatment is either down the effluent. The use of anaerobic reactors is usually a first stage treatment to break down particularly high strength effluent before treatments in a second aerobic stage. Both processes are relatively slow and may necessitate the use of large tanks/lagoons or compact mechanical systems. Biological treatment is a sensitive process requiring controlled operating conditions with constant effluent supply.

Tertiary Treatment: Considered to be a final cleaning/polishing stage, used if necessary to remove any remaining traces of contamination or to produce a high quality treated effluent that may enable the water to be re-used (recycled) for specific low risk uses. Treatment process can include fine filtration (sand filtration, nano-filtration), reverse osmosis, nitrification, granular activated carbon or sterilisation/disinfection.

Main Pollutant

Pollutant	Treatment	Comments
pH	Acidic pH adjusted through the addition of an alkali e.g. Sodium Hydroxide or Lime. Alkali pH adjusted through the addition of an acid e.g. Hydrochloric sulphuric or carbon dioxide	Accurate pH adjustment from either highly alkaline or highly acidic conditions may be difficult to achieve using in-line dosing techniques Use of buffer/mix tanks to allow more accurate control of the treated water pH may be beneficial.
Suspended Solids	Treatment within settlement tanks, upward flow clarifiers and lamella clarifiers to recover medium and coarse particles which will settle to the base of the unit Low density (buoyant) solids e.g. organic waste and algae may be recovered using dissolved air flotation techniques. Addition of coagulants and flocculants to recover fine (clay sized) and colloidal particles. Low concentrations of suspended solids may be recovered by water filtration	The solids are usually recovered as a sludge. Further dewatering and/or thickening of the sludge may be required as a means of reducing waste disposal costs and improving the handleability of the materials. Filtration systems will periodically need to be backwashed and/or the filter media replenished. Filtration is commonly seen as a polishing stage used to recover residual low concentration of solids. Where high concentration of suspended particles are present, a two stage approach settlement or floatation to remove gross concentrations of solids, followed by filtration to polish the effluent may be implemented.
BOD	May be present as either suspended particles (see suspended solids) or dissolved. Where present as dissolved BOD, commonly is treated via biological (destruction using microbes) or chemical oxidation.	High BOD levels may inhibit biological activity, requiring need for pre-treatment or homogenisation of differing waste streams to achieve a satisfactory level. Biological systems need to be operated on a continuous basis to prevent microbes becoming dormant.
COD	JFH May be present as either suspended particles (see suspended solids) or dissolved. May be resistant to biological destruction, necessitating the need for addition of a chemical to oxidise the materials, eg addition of hydrogen peroxide.	Stats Chemical oxidation systems can be operated in either a batch or continuous basis.
Metals	JFH Typically removed by precipitation as an insoluble compound eg Hydroxide. To minimise the concentration of metals in the treated water, pH adjust may be required to adjust the pH of the water to the low point on the metals, solubility curve. Where metals may be present in a reduced form oxidation of the metals though the addition of compressed air or hydrogen peroxide may be required prior to precipitation.	The precipitated metals will be recovered as a sludge, depending on the metal recovered this sludge may either be classified as non-hazardous or as hazardous. Dewatering of the sludge is normally undertaken as a a means of minimising the moisture content, thereby reducing disposal costs.
Fats Oil and Greases	JFH Typically recovered in oil water separators which may be either be, open topped tanks, inclined plate, coalescing media or utilise dissolved air flotation.	Treatment systems may be fitted with systems which automatically remove the trapped oil and grease enabling the units to operate continuously.

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Effluent Management Support Services

John F Hunt Water Technologies can provide a range of Effluent Management and Support Services from initial scheme assessment through to plant commissioning and optimisation. Where required, John F Hunt Water Technologies can provide both manpower to operate a company's water treatment plant and manage the procurement of consumables and disposal and treatment of waste arisings.

1. Scheme Appraisal
2. Compliance Monitoring
3. Plant Design
4. Delivery, Installation and Commissioning
5. Plant Optimisation, including jar tests
6. Development of Capex and Opex Budgets

Spreading the Cost

A company's financial constraints may make it difficult to instantaneously raise the finances to implement capital works.
John F Hunt recognises this and has the ability to provide treatment systems via a variety of routes such as:

Hire On-going hire of equipment, with the ability to off-hire the equipment at an agreed notice period and with the flexibility to upgrade and/or down size the system to reflect the current nature of the site operations.

Hire to Buy At the end of an agree hire period, the Client may exercise an Option to purchase the system. The combination of hire and purchase allows the client to effectively trial the equipment prior to committing to the outlay of capital.

Lease The treatment system is leased by the Client, a range of additional services eg Maintenance, provision of manpower to operate can be easily incorporated into the lease arrangements. Lease durations typically may be of long duration, providing a company with future certainty over wastewater treatment costs.

Hire, Hire to Buy and Lease Options provide companies with alternative routes which enable a company to procure treatment systems in a flexible way, minimising the risk associated with a large capital outlay and uncertain economic conditions.

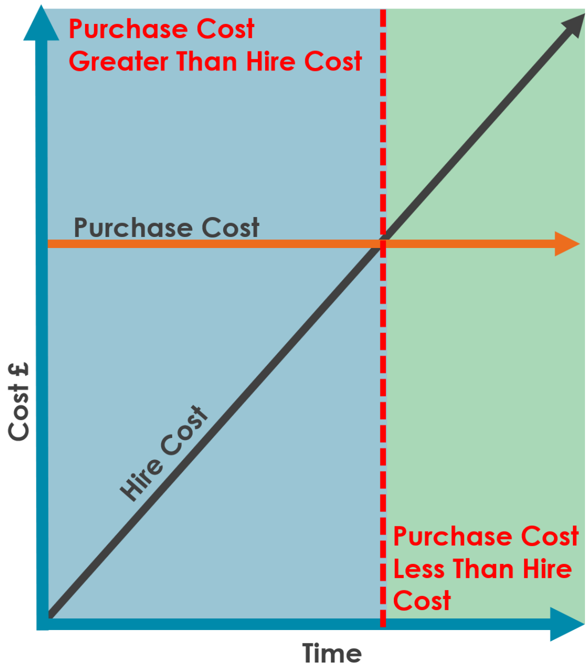
To Hire or Purchase

Hire

- On-going cost
- Never own equipment
- Flexibility to react to changing circumstances
- For short term can be cheaper than purchase option
- No need to have direct access to spare parts
- Treatment capacity can be easily scaled up or down in response to changes

Purchase

- One-off cost or staged payment by finance arrangements
- Own equipment
- Scope of plant fixed, additional purchases needed to accommodate changes
- For long duration projects can be cheaper than hire
- Need to have direct access to spare parts

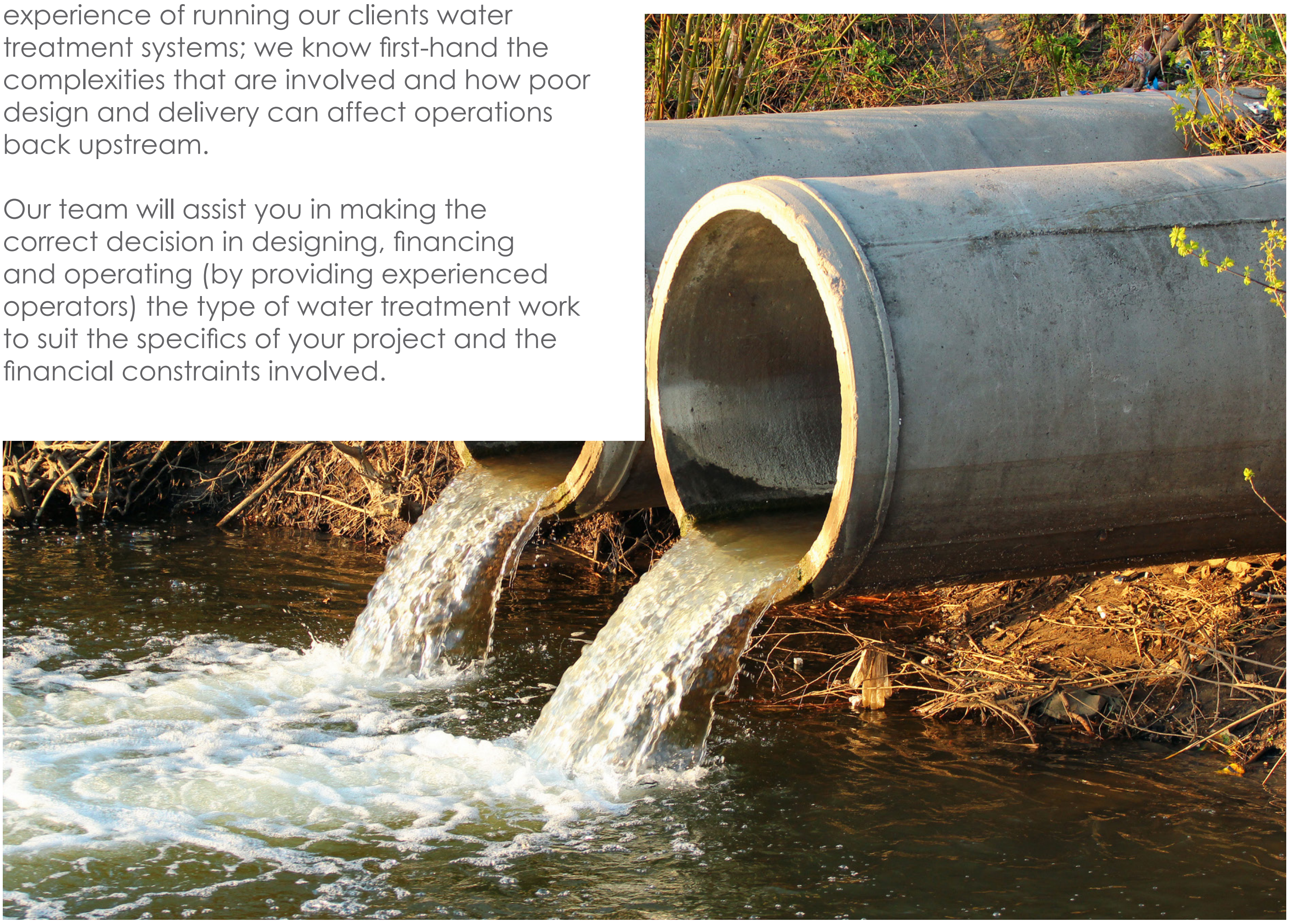


Need to understand at what point in time relative to the duration of the project does the hire costs exceed the purchase costs……………..

Project Support

John F Hunt Water Tech has many years' experience of running our clients water treatment systems; we know first-hand the complexities that are involved and how poor design and delivery can affect operations back upstream.

Our team will assist you in making the correct decision in designing, financing and operating (by providing experienced operators) the type of water treatment work to suit the specifics of your project and the financial constraints involved.



John F Hunt
REGENERATION

Contact Us

Tyne and Wear

Station Lane
Birtley
Tyne and Wear
DH2 1AJ
01914 111 200

Market Harborough

Harborough Innovation Centre
Wellington Way
Airfield Business Park
Leicester Road
Market Harborough
LE16 7WB
01858 414 333

West Midlands

Fairfield Road
Halesowen
West Midlands
B62 9JL
0121 2703 199

Grays

London Road
Grays
Essex
RM20 4DB
01375 366 700

Bristol

Bradley Road
Portbury
Bristol
BS20 7NZ
01275 400 560

Canterbury

Canterbury Innovation Centre
University Road
Canterbury
Kent
CT2 7FG
01227 811 826

For additional information contact John F Hunt Water Tech at:

info@johnfhuntregeneration.co.uk
+44(0)1375 366 700

johnfhuntregeneration.co.uk