Int. J. Water, Vol.X, No. X, pp. XXX, XXX

Blackburn Meadows wastewater treatment works

Rui Lima

Gab. 23, Instituto Politécnico de Bragança, Escola Superior de Tecnologia e de Gestão, Campus de Santa Apolónia, Apartado 134, 5301-857 Bragança, Portugal.
E-mai1: ruimec@ipb.pt

Robert Bachmann

Department of Chemical and Process Engineering, Sheffield University, Mappin Street, Sheffield, S1 3JD, UK.
E-mail: r.t.bachmann@sheffield.ac.uk

Abstract: Blackbum Meadows wastewater treatment works is situated in Sheffield, the fourth largest city in England, in the county of South Yorkshire. This treatment plant has a fluidized bed incinerator in order to treat and dispose the sludge.
This paper gives a brief overview of the various stages and processes involved in effluent treatment at Blackbum Meadows and assesses the sludge disposal operation.

Keywords: Sewage treatment plant; sludge dewatering; sludge incineration; wastewater.

Reference to this paper should be made as follows: Lima, R. and Bachmann, R. (2002) 'Blackbum Meadows wastewater treatment works', *Int. J. Water*, Vol. 2, No. I, pp. 35-39.

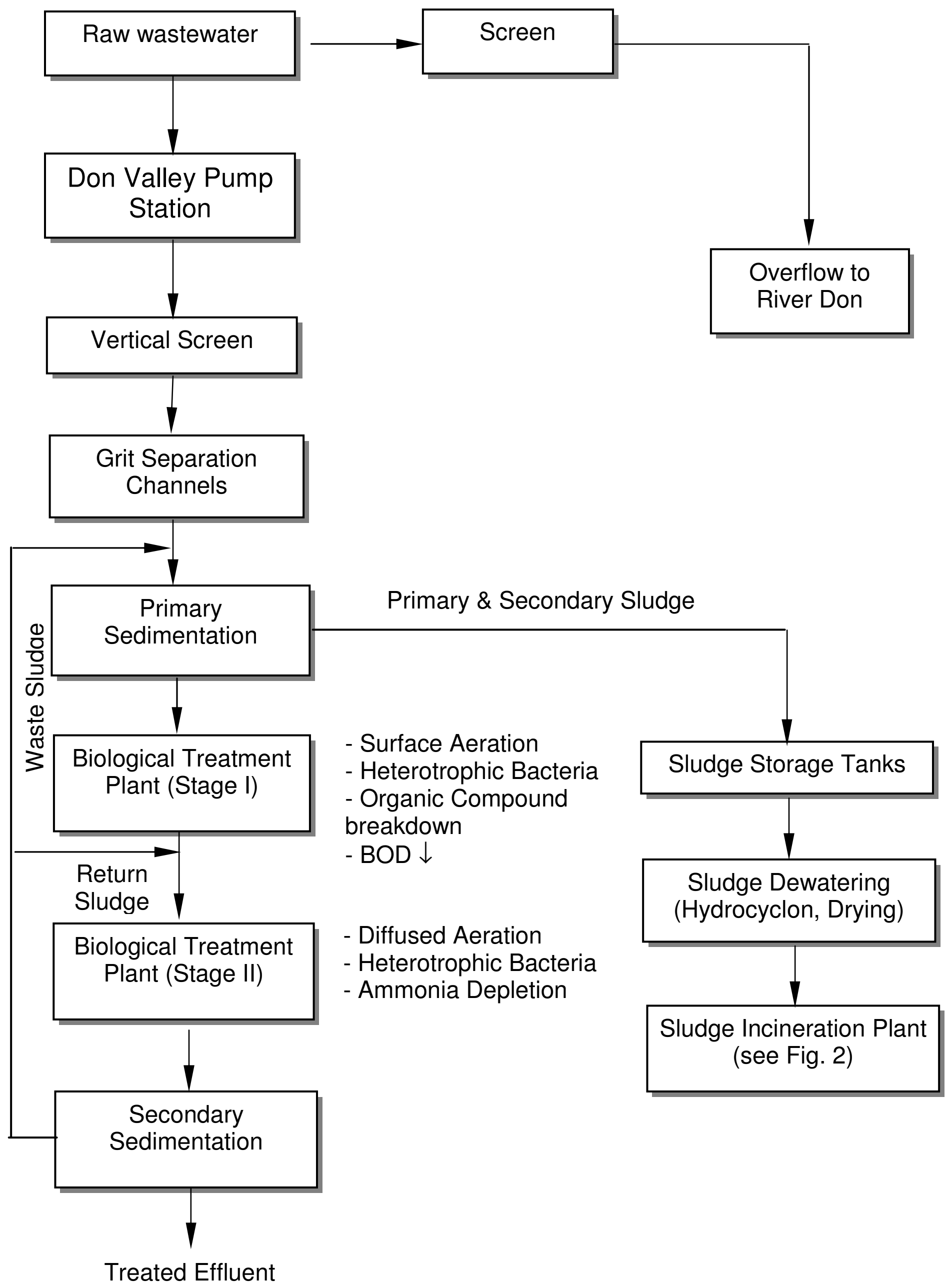
1 Introduction

The Blackburn Meadows works is one of the largest in South Yorkshire and discharges treated sewage from a population of 444,000 into the River Don. The present dry weather flow (DWF) is 136,000 m^3 per day, which is more than the rate of flow in the River Don upstream of the discharge in dry weather.
The incoming sewage comes from the Don Valley interceptor sewer, Tinsley and Blackburn Valley.

2 The new Don Valley interceptor sewer

The original combined sewerage system that ran through Sheffield had become overloaded due to an increase in population, increased water consumption and increased industrial activity. This led to many water overflows and unscreened sewage being discharged to the River Don. The new interceptor sewer now carries most of this combined flow to the treatment works (Figure 1), although several new overflows occurred for times of very heavy rainfall.

Figure 1 Diagram of the Blackbum Meadows Wastewater Treatment Works



A large amount of storm flow can be stored in the sewer due to its large diameter, varying from 1.5 m diameter at the head of the system to 5.5 m at the lower end. When the storage available in the sewer and the shaft has been fully utilized, flows in excess of 6 Dry Weather Flow (DWF) are discharged to the overflow channel via coarse screens. This overflow channel carries flow around the edge of the works and discharges it directly into the River Don.

2.1 Preliminary treatment

The equipment under this heading is mainly intended to protect downstream processes and mechanical equipment. At this stage, up to 6-DWF passes through coarse bar screens. The screens are raked mechanically and the screenings are washed, compressed and collected in a skip. These are then buried on site.

The flow then passes into aerated grit channels, where the organic matter is kept in suspension by the compressed air which is bubbled through the flow. Grit settles to the bottom of tanks and is pumped out by travelling pumps. The grit is also buried on site. After the grit channels, the flow passes between two side weirs which discharge the excess flow between 3 DWF and 6 DWF to storm tanks. The screened sewage in the storm tanks is then pumped into the main treatment works once the storm event has subsided.

2.2 Primary treatment

Primary treatment consists of eight rectangular sedimentation tanks fed by a transverse tapering channel to facilitate even distribution of flow to each tank. Sewage enters the tanks via a baffle chamber and is collected at the opposite end over a weir.

Sludge is scraped from the sloping floor of the tank towards a sludge hopper located below the inlet and is pumped out and stored before further treatment. Surface scum is also collected and stored before disposal. The primary sedimentation process removes approximately 70% of the settleable solids.

2.3 Secondary (biological) treatment

There are two types of biological treatment: the simplex aeration plant, to which 40% of the flow passes and the new plant, with 60% of the flow.

The simplex aeration plant consists of 16 aeration pockets where floating aeration cones keep the dissolved oxygen high and continually mix the sewage. This plant does not nitrify the effluent.

The new aeration plant consists of an anoxic zone, simplex aeration pockets and diffused air aeration. This process fully nitrifies the effluent, and the anoxic zone allows denitrification to take place. The new plant reduces ammonia levels to a point well below the required effluent standard, so that when this effluent is mixed with non-nitrified effluent the final effluent standard is achieved.

2.4 Secondary sedimentation process

At this final stage, circular sedimentation tanks with continuous sludge scraping are used. The flow enters at the center of the tank, just below the water surface inside a baffle, to prevent disturbing the tank contents. The discharge is over a peripheral weir, which is protected by a scum board.

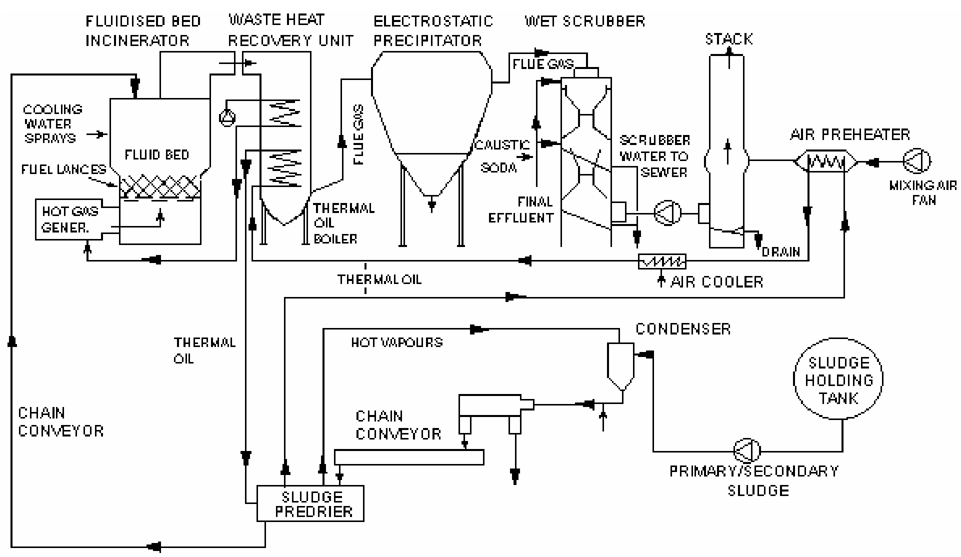
2.5 Effluent standards of the flow

The crude sewage entering the WWTW has a BOD 200 mg/L, suspended solids 250 mg/L and ammonia 25 mg/L, approximately. After treatment the final effluent contains less than BOD 15 mg/L, suspended solids 30 mg/L and ammonia 5 mg/L.

2.6 The primary sludge

The primary sludge is stored and thickened in tanks containing picket fence thickeners, and then fed into another set of holding tanks, as depicted in Figure 2. The sludge is then heated to approximately 40 °C by waste heat from the predryer, and is then conditioned by a polyelectrolyte solution. After that, the sludge passes into the centrifuge and another dryer to produce a sludge cake of approximately 28% solids. This cake is then fed to a fluidized bed incinerator where it is burnt, producing ash and waste gases. Both the ash and gases are cleaned before the ash is buried on site and the gases discharged to atmosphere.

Figure 2 Diagram of the sludge dewatering and incineration plant. Source: Tolan. Bennett and Kwiecinski [I].



2.7 The activated sludge

Most of the activated sludge is returned to the activated sludge plant to keep the sludge solids. However, an excess is produced and this is returned to the sewage flow just upstream of the primary tanks so that it can co-settle with the primary sludge and be treated of in the same way as the primary sludge (Fig. 1).

3 Conclusion

Up until several years ago, attempts were made to use the sludge as an agricultural fertilizer but the heavy metals content of the sludge precluded this. As a result, at Blackburn Meadows works incineration is at the moment accepted as the best practical disposal option.

Acknowledgements

The authors wish to thank Dr. M. Hogg and Dr. D. Ward for their valuable guidance and comments. Special thanks must go to the engineers in Blackbum Meadows wastewater treatment plant for their kindness in providing precious information during our visit.

References

1 Tolan, B., Bennett, D. and Kwiecinski, J. (1991) "Blackbum Meadows Sewage Treatment Works: Sludge Incineration into the 1990s"; paper from IWEM 90 Conference, pp.239-249.

2 Kwiecinski, J. (1993) "Yorkshire: Sludge Incineration Experience*", UK Water Projects* 1993 Edition, pp.200-201.

3 Denton, R. "Industrial Waste Water Treatment -Selecting Cost Effective Solutions for Industrial Effluent Treatment*", Environmental Protection Bulletin* 021, pp.21-24.